DOCUMENT RESUME

ED 026 856 24 EM 007 007

By-Osburn, H. G.; Shoemaker, David M.

Pilot Project on Computer Generated Test Items.

Spons Agency-Office of Education (DHEW), Washington, D.C. Bureau of Research.

Bureau No-BR-6-8533

Pub Date 1 Jun 68

Grant-OEG-1-7-068533-3917

Note-171p.

EDRS Price MF-$0.75 HC-$8.65

Descriptors-*Achievement Tests, Evaluation Techniques, *Measurement Techniques, *Test Construction, Test Interpretation, Test Selection, Test Validity

A computer program generating question series for achievement examinations was presented and the relative reliability of computer-generated and instructor-selected items was investigated. To provide validity for examinations generated by an original computer program, representative processes of construction and sampling were operationally defined. A behavior list representing a molar analysis of essential topics in elementary statistics was prepared from text and class materials, and one or more item forms (performance questions) for each item in the list were defined. The program generated examinations by randomly selecting item forms from each element referenced. Two university level elementary statistics classes received a series of examinations composed of both computer-generated and instructor-selected items. While items selected by an instructor were found to have greater reliability, the computer-generated series evidenced coefficients of an acceptable level. Student reaction was considered favorable, with difficulty and fairness of computer- and instructor-supplied items judged comparable on a post-examination questionnaire. The further development and use of computer-generated examinations were considered substantially encouraged by the obtained data. (SS)

ED0 26856

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Final Report

Project No. 6-8533
Grant No. OEG-1-7-068533-3917

Pilot Project on Computer Generated Test Items

H. G. Osburn
University of Houston

David M. Shoemaker
Oklahoma State University

Houston, Texas
June 1, 1968

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education and Welfare. Contributors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgement in the conduct of the project. Points of view or opinions stated do not, therefore necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION AND WELFARE

Office of Education
Bureau of Research

EM007007

Table of Contents

Page

Summary 1-2

Chapter

1. Background and Purpose 3-5

   Theoretical Background
   Purpose

2. Method and Procedures 6-9

   The Computer Item Generating Program
   Development of Item Forms
   Experimental Tryout of Item Forms
      Samples
      Experimental Tests
      The Student Questionnaire

3. Results, Discussion and Conclusions 10-26

   Results on the Fall-1967 Sample
      Statistical Characteristics of Computer Items
      Student Reaction to Computer Items

   Results on the Spring-1968 Sample
      Statistical Characteristics of Computer Items
      Student Reaction to Computer Items

   Discussion and Conclusions

References 27

Appendices

A. Behavior List for Elementary Statistics 28-35

B. Item Form List for Elementary Statistics 36-58

C. Test Used in the Study 59-71

D. Student Questionnaire 72-76

E. Program Manual 77-95

F. Program Statements 96-124

G. Sample Item Sentences 125-166

List of Tables

		Page
1.	Item Composition of Tests	11
2.	Intercorrelation Matrix Fall-1967 Sample	12-14
3.	Item-Test Correlations and Estimated Reliability Coefficients Fall-1967 Sample	15
4.	Intercorrelation Matrix Spring-1968 Sample	20-21
5.	Item-Test Correlations and Estimated Reliability Coefficients Spring-1968 Sample	22

Summary

This study is based on the concept that it is possible to define what a test is measuring by specifying operational procedures for the construction and sampling of test items. The implementation of this point of view involves definition of meaningful stimulus classes and systematic sampling from the classes so defined. This study explores the possibilities of using a digital computer for item sampling from predefined stimulus classes.

The primary purpose of the study was to tryout the concept of computer generated test items in the context of an actual course of instruction to determine the operational feasibility of the technique. The study consisted of three phases (1) development of a computer item generating program, (2) specification of a system of item forms in the content area of elementary statistics and (3) tryout of item sentences sampled from the universe of content using college students in elementary statistics.

The criteria used to evaluate the computer generated item technique consisted of (1) the reliability of computer generated items compared with instructor made items (2) student reaction to the technique and (3) general experience in attempting to generate items by computer.

The results of the study suggested that the computer generated test items used in the study were slightly less reliable than the instructor made items. However, the reliability of the computer

generated items was not unacceptably low. Student reaction to the technique was generally positive and there were increasingly favorable reactions as some of the bugs were worked out of the method.

Experience with using a computer to generate test items suggested that the method used in this study was quite limited and that more flexible data structures will be required.

Chapter 1

Background and Purpose

A. Theoretical Background

An extended discussion of the theoretical background for this study has recently been published in the Journal of Educational and Psychological Measurements, Osburn (1968); therefore only a condensed version is offered here. The interested reader is referred to the longer paper.

The basic theoretical concept is that the objective of achievement testing is generalization to a well defined universe of content. We are usually not intrinsically interested in an examinee's performance on the particular items in a test. Rather we would like to make inferences regarding his knowledge and skills with respect to some larger content domain. The typical achievement test is an arbitrary collection of items - of little value unless valid inferences can be made regarding the examinee's behavior in some wider context.

The usual approach to the measurement of achievement is to think of the examinee as possessing a measureable amount of "knowledge" where knowledge has the status of a hypothetical construct mediating behavior on the test with other important behaviors of the examinee. Knowledge is conceptualized implicitly as a latent hypothetical continuum and the measurement problem is reduced to a question of making inferences about the latent hypothetical continuum from analysis of responses to test items. Somewhere along the line the hypothetical continuum is given a name such as number facts, 10th grade mathematics, etc. and the illusion that something meaningful is being measured is complete.

There are many serious problems with the above described approach to achievement testing. First and foremost it is very difficult to establish what an achievement test is measuring in functional terms. The usual strategy is to attempt to determine the construct validity of the test. This seems reasonable except that in actual practice it often comes down to correlating scores on one set of arbitrary items with a second set of equally arbitrary items where both sets are referred to the same or similar constructs. This is not to say that achievement testing is completely arbitrary. Subject matter outlines are drawn up and the items are often distributed in some systematic fashion across subject matter elements. However, as a rule items are not sampled in any rigorous sense and there is not a direct link between the definition of the universe of content and the items that appear on any particular test. To establish such a link requires that all items that could possibly appear on the test to be specified in advance so that random or stratified random sampling can be rigorously implemented.

The basic strategy of the present study is to attempt to define what the test is measuring by specifying the operational procedures for the construction and sampling of test items. Validity is not established solely by reference to the responses of examinees, but rather by a careful definition of the stimuli. To paraphrase Hively, Patterson and Page (1968) - Classes of stimuli may be defined by stating sets of relevant and irrelevant properties. Classes of responses may be defined by stating one or more properties or criteria. Knowledge may then be operationally defined as a functional relation between certain classes of stimuli and classes of responses. One can "diagnose" an individual's knowledge by testing him with sample of stimuli, varying the stimulus properties systematically, and observing the occurence of defined responses.

In principle at least the validity of an achievement test may be established for a single subject by showing that a functional relationship exists between classes of stimuli and classes of responses. The implementation of this point of view involves definition of meaningful stimulus classes and the systematic sampling from the stimulus classes so defined. In the author's opinion the definition of stimulus classes is the principle problem in achievement testing.

One possibility for the systematic sampling of items from a defined set of stimulus classes is to analyze the content domain into a hierarchical arrangement of item forms and develop a program for a digital computer that will compose item sentences given a suitable vocabulary and structural codes for the item forms. An item form has the following characteristics: (1) it generates items with a fixed structure; (2) it contains one or more variable elements; and (3) it defines a class of item sentences by specifying the replacement sets for the variable elements. An item form may be very general or abstract or quite specific and particular. The analysis of a content domain into item forms proceeds from the general to specific in much the same way as an ordinary subject matter outline with one crucial difference - in item forms analysis there is an unbroken link between the abstract system and the individual item sentence. This property makes it possible to unambiguously define a universe of content as an hierarchical arrangement of item forms together with the replacement sets for the variable elements.

B. Purpose

The primary purpose of this study was to tryout the concept of computer generated test items in the context of an actual course of instruction to determine the operational feasibility of the technique. The statistical characteristics of computer generated items as compared with instructor made items and student reactions to the computer items were the principle criteria used to access feasibility along with experience in attempting to actually implement the procedure.

Chapter 2

Method and Procedures

A. The Computer Item Generating Program

During the summer of 1967 a computer program was developed by David Shoemaker and the author for generating test items using the item form concept. The program was multi-purpose in the sense that (1) it could accept as data the raw material for item forms; (2) it could stratify item forms into classes or strata for sampling purposes; and (3) it could generate random item sentences according to the sampling plan specified by the investigator. The program was in block form in the sense that the various phases of the item generation process were independent of each other and could be initiated by means of a control card. The process of item generation was broken down into the following phases:

1. Coding of Replacement Sets - Replacement sets for item forms were inputted as character data. The computer program coded the replacement set in such a way that the set could be referenced and an element of the set could be randomly selected as needed.

2. Random Number and Frequency Distributions - The program provided for the generation of several types of random numbers, frequency distributions, probability distributions and joint distributions. The program operated on code read in as part of an item form or random replacement set. The code specified the desired characteristics of the random number, frequency distribution, etc.

3. Coding of Item Forms - Item forms were inputted as character data, coded references to random replacement sets, and coded references to random numbers. The computer coded the item forms in such a way that the item form could be referenced by number and the computer could assemble the various elements of an item form and print out a particular item sentence.

4. Stratification of Item Forms - Stratification of item forms was accomplished by inputting item form code numbers referenced to the desired strata. Thus, stratification could be modified by data input.

5. Generation of Tests - The computer program generated tests by selecting one random item sentence from each stratification referenced by the input command. If more than one item per strata was desired, the strata was multiple referenced.

The program was written in FORTRAN IV compatible with the Sigma 7 and the 7090 series computers. Four tapes were utilized for data storage. Data for about 100 item forms could be stored and processed in one pass through the computer. The users manual describing the control cards and the various random number and format codes is presented in Appendix E of this report. The program statements are presented in Appendix F.

B. Development of Item Forms

The first stage in the development of the item forms used in this study was to construct a behavior list covering significant tasks that the competent student should be able to perform correctly. The scope of the behavior list was roughly equivalent to chapters 1-10, 16 and 17 in Statistics for Psychologists by William L. Hays. The behavior list represents a rather molar analysis of the chosen topics in elementary statistics and assumes that the student has access to a text and class notes. As it turned out many of the items on the behavior list were not applicable to the classes in elementary statistics on which data were collected. The text actually used in the experimental classes was Fundamental Statistics in Psychology and Education by J. P. Guilford. For this reason many of the items on the behavior list were not used in the present study. The behavior list is presented in Appendix A of this report.

Item forms were developed by taking each element of the behavior list and attempting to define one or more item forms for the behavior element. The item forms that emerged were heavily computationally oriented. This was partly due to the open book type of examination for which the item forms were designed, and partly due to the bias of the author. A writing team would be required to develop a really comprehensive set of item forms. The objective of this pilot study was to evaluate the feasibility of the procedure rather than develop a comprehensive set of item forms.

One other characteristic of the item forms used in this study was that they were not completely specified as to content. Only the general structure was specified and the actual content of the item form was developed as it was composed for computer input. The item form list is presented in Appendix B of this report. One random item sentence from each item form is presented in Appendix G.

C. Experimental Tryout of Item Forms

1. Samples

Two samples were used in this study. The first sample consisted of 27 students in a senior level course in elementary statistics for psychologists at the University of Houston during the fall semester of 1967. The text for the course was Fundamental Statistics in Psychology and Education by J. P. Guilford. The course was taught by the author. The general characteristics of the sample were as follows: Of the 27 students 78% (21) were taking their first statistics course. While the majority of the students were psychology majors (14), a wide variety of majors were represented: biology, math, speech, economics and English. The mean age of the sample was 24.7 years (SD=4.8) and 67% (18) were male. A majority were undergraduates (16).

A second sample of students taking the same course was studied during the spring semester of 1968. The instructor and text were the same as for the first sample. The characteristics of the second sample were as follows: Of the 21 students 86% were taking their first course in statistics. Only about one-fourth of the students were psychology majors with a wide variety of majors other than psychology represented. The mean age of the sample was 24.48 years and 71% (15) were male. Thirteen were undergraduates and 8 were graduate students.

2. Experimental Tests

Three tests were administered to the Fall-1967 sample. For comparison purposes the tests were composed of a mixture of computer generated and instructor made items. The item composition of each test is presented in Table 1. It is important to note that the computer generated items were not truly random item sentences as some selection among computer generated items was required due to difficulties with the computer program. It can be said that the computer generated items were representative but not truly randomly sampled. All tests used in the study are presented in Appendix C of this report.

Since it was necessary to terminate the study prior to the end of the spring semester 1968, only two experimental tests were studied for the spring 1968 sample. The composition of these two tests is also presented in Table 1.

One to two weeks prior to each test samples of two random item sentences from each item form that could appear on the test were passed out to the students as study guides. The students were told that some of the items on the forthcoming test would be randomly sampled from the same universe of content as the sample items. It was made clear that in all probability exact duplicates of the sample items would not appear on the test.

3. The Student Questionnaire

A questionnaire was constructed for the purpose of assessing student reaction to the computer generated items. This questionnaire was given to the fall-1967 sample just after the final examination in the course. It was given to the spring-1968 sample about one week after the second examination. A copy of the student questionnaire is in Appendix D of this report.

Chapter 3

Results, Discussions and Conclusions

A. Results on the Fall-1967 sample

1. Statistical Characteristics of Computer Items

The three tests given to the fall-1967 sample contained a mixture of instructor made and computer generated items so that comparisons could be made. It should be emphasized that these comparisons are in no way definitive since the instructor made items were arbitrary and the computer program from time to time generated defective items so that these items were not truly randomly sampled. Nevertheless, a rough idea of the statistical characteristics of the computer items can be obtained while recognizing the limitations of the study.

The item means, standard deviations and intercorrelations for the three tests are presented in Tables 2a, 2b and 2c. Inspection of these tables shows that the items within a particular test were moderately intercorrelated with test 2 having the most homogeneous items. Also the item total score correlations are in the expected range with the exception of two items (item 5 in test 1 and item 2 in the final examination). Both of these items were computer generated. The suggestion from these data is that the computer generated items may be a little less homogeneous than the instructor made items.

The overall results are presented in Table 3. These data show that the computer generated items were slightly less reliable per item than the instructor made items. This is also reflected in the slightly lower average item-sum score correlations for the computer generated items. Test 1 consisting of computer items only showed the lowest reliability. Thus the weight of the evidence points to a slightly lower reliability for the computer items. On the other hand the differences are slight suggesting that the price in lower reliability that

Table 1

Item Composition of Tests

Fall-1967 Sample

Item Classification	Test 1	Test 2	Final	Total
Instructor Items	0	4	4	8
Computer Items	7	5	6	18
Total	7	9	10	26

Spring-1968 Sample

Item Classification	Test 1	Test 2	Total
Instructor Items	3	1	4
Computer Items	5	6	11
Total	8	7	15

Table 2a

Intercorrelation Matrix-Test 1

Fall 1967 Sample

(N=26)

Variable	1	2.	3	4	5	6	7	Total Score
Item 1 C[1]	1.0							
2 C	.14							
3 C	.57	.01						
4 C	.23	.11	.37					
5 C	-.33	.06	-.12	-.06				
6 C	.32	.41	.40	.34	.13			
7 C	.32	.07	.56	.25	.03	.46		
Total Score	.47	.39	.68	.57	.13	.85	.74	1.0
Mean	4.77	4.12	4.23	8.92	4.12	4.15	7.38	37.69
SD	.639	1.154	1.625	1.940	.974	3.570	2.719	8.147

---

[1] C - Computer-generated item; I - Instructor-made item.

Table 2b

Intercorrelation Matrix-Test 2

Fall 1967 Sample

Variable	1	2	3	4	5	6	7	8	9	Total Score
Item 1 I[1]	1.0									
2 I	.54									
3 I	.31	.14								
4 I	.45	.45	.56							
5 C	.37	.21	.59	.51						
6 C	.52	.20	.50	.44	.68					
7 C	.27	.34	.48	.25	.60	.49				
8 C	.61	.38	.49	.50	.27	.46	.15			
9 C	.31	.29	.64	.63	.66	.44	.56	.51		
Total Score	.61	.50	.76	.72	.76	.70	.71	.67	.86	1.0
Mean	5.32	5.39	3.79	3.29	3.04	4.11	4.46	7.71	8.43	45.54
SD	1.733	1.543	2.623	2.328	1.861	1.697	4.420	3.183	4.762	17.475

---

1. C - Computer-generated item; I - Instructor-made item.

Table 2c
Intercorrelation Matrix-Final Examination
Fall 1967 Sample
(N=23)

Variable	1	2	3	4	5	6	7	8	9	10	Total Score
Item 1 C[1]											
2 C	.00										
3 C	.55	.18									
4 C	.28	-.12	.16								
5 C	.35	-.15	.34	.42							
6 C	.37	.25	.59	-.05	.37						
7 I	.27	-.18	-.00	.29	-.19	.10					
8 I	.28	-.17	.33	.56	.06	.06	.48				
9 I	.53	-.22	.33	.41	.34	.29	.33	.32			
10 I	.32	-.08	.47	.62	.52	.23	.33	.58	.42		
Total Score	.69	-.08	.64	.61	.56	.53	.48	.62	.73	.80	1.0
Mean	6.32	4.86	2.96	4.11	7.5	6.71	6.93	7.50	9.71	9.21	65.82
SD	4.209	.580	2.412	1.780	4.196	4.139	4.317	3.660	5.830	6.020	23.429

---

1. C - Computer-generated item; I - instructor-made item.

Table 3

Item-test Correlation and Estimated Reliabilities: Fall-1967 Sample

				Estimated	Reliability
	N	$\bar{r}_{gt}$[1]	$\bar{r}_{gs}$[2]	Test[3]	Item[4]
Test 1	7	.59	.49	.65	.21
Test 2	9	.71	.63	.84	.37
Final	10	.60	.58	.93	.56
Instructor	8		.61	.77	.29
Computer	18		.56	.85	.24

1. $\bar{r}_{gt}$ - The average item-test score correlation for each test.
2. $\bar{r}_{gs}$ - The average item-sum score correlation where the sum score is the sum of the three tests.
3. - Coefficient alpha computed by analysis of variance.
4. - Estimated reliability per item.

one might have to pay for the advantages of the computer item technique may not be too high.

2. Student Reaction to Computer Generated Items

Immediately following the final examination the student questionnaire was administered to the fall-1967 sample for the purpose of evaluating their reaction to the computer generated items. The first two questions concerned an evaluation of the perceived difficulty and effectiveness of the course as a whole.

1. Please rate the difficulty of the course in terms of learning to understand statistical concepts.

   22% Very difficult
   26% Moderately difficult
   33% About average
   19% Moderately easy
   00% Very easy

2. To what extent do you think this course was effective in teaching statistical concepts?

   26% Very effective
   48% Moderately effective
   19% About average
   04% Moderately ineffective
   03% Very ineffective

Responses to these two items indicate that the majority of the students felt that the difficulty level of the course was average to difficult in terms of the concepts involved and that the instruction was moderately to very effective. Surprisingly, students with a prior statistical background tended to judge the course as being more difficult than the non-experienced students. The open-ended comments to this question suggested that the course would be more effective if the concepts had been related more closely to practical applications. This criticism was also made of the computer items.

The next two questions were concerned with the extent to which the sample computer generated items helped to define the objectives of the course.

3. Prior to each test you were given samples of statistics problems drawn from a defined universe of content.

   a. To what extent did you use these sample problems to study for the test?

      00% Used as only source
      19% Used more than any other sources
      59% Used equally with other sources
      22% Used other sources more
      00% Did not use at all

   b. To what extent did you feel that the sample problems adequately defined what you had to learn in the course?

      37% Very valuable
      56% Somewhat valuable
      00% Of no value
      04% Somewhat detrimental
      03% Very detrimental

Responses to these two items indicate that according to student report the sample items were of definite value in defining the objectives of the course and that the sample items tended to be used as study guides about equally with other sources of information. Open-ended comments on this question suggested that the sample problems would have been more meaningful if the answers had been provided.

Four questions asked for a comparison between the computer generated items and instructor made items.

4. Some of the problems on your tests were generated by a computer from a defined universe of content.

   a. Did you find the computer generated items more difficult or easier than instructor made items?

      30% Very difficult
      26% Somewhat more difficult
      41% About the same
      04% Somewhat easier
      03% Much easier

   b. Do you feel that your knowledge of statistics could be adequately tested using only test problems sampled by the computer?

04% All of the time
30% Most of the time
41% Some of the time
15% Little of the time
11% Very little of the time

c. How did the computer generated problems compare with instructor made problems in terms of fairness?

19% Very fair
07% Moderately fair
44% About the same
26% Moderately unfair
04% Very unfair

d. Do you think that it would be desirable to draw all test problems from a defined universe of content?

26% Very desirable
44% Somewhat desirable
11% Does not matter
15% Somewhat undesirable
04% Very undesirable

Responses to the above four items indicate that computer generated items were perceived as more difficult than instructor made items and about the same in terms of fairness. The majority indicated that knowledge of statistics could be adequately measured at least some of the time by computer generated items and it would be somewhat to very desirable to draw all test problems from a defined universe of content. Open-ended comments on these items suggested that the computer generated items were more difficult because of notation problems introduced by the limited character set for computer print out.

B. Results on the Spring-1968 sample

1. Statistical Characteristics of Computer Items

Only two tests were studied on the Spring-1968 sample due to the necessity of terminating the study by June 1, 1968. The item composition of these tests is presented in Table 1.

The item means standard deviations and intercorrelations are presented in Tables 4a and 4b. These data show that the items within a particular test are moderately intercorrelated with test 1 having the most homogeneous items. Only two of the fifteen items failed to correlate with the total score for that test (item 4 in test 1 and item 3 in test 2) both of these items were computer generated items. Thus as was found in the previous sample the computer generated items appear to be a little less homogeneous than instructor made items.

The overall results are presented in table 5. These data show that the computer generated items are considerably less reliable per item than the instructor made items. Thus, the finding of lower reliability for computer item that emerged in the Fall-1967 sample appears to be strengthened by these data.

2. Student Reaction to Computer Items

The student questionnaire was administered to the spring-1968 sample about one week following the second test. Responses of the spring-1968 sample to the first two questions were as follows:

1. Please rate the difficulty of the course in terms of learning to understand statistical concepts.

   10% Very difficult
   33% Moderately difficult
   29% About average
   29% Moderately easy
   00% Very easy

2. To what extent do you think that this course was effective in teaching statistical concepts?

   38% Very effective
   48% Moderately effective
   14% About average
   00% Moderately ineffective
   00% Very ineffective

The spring-1968 sample shows a more positive response to items 1 and 2 than did the fall-1967. The course was seen as significantly less

Table 4a
Intercorrelation Matrix-Test 1
Spring 1968 Sample
(N=26)

Variable	1	2	3	4	5	6	7	8	Total Score
Item 1 C[1]	1.0								
2 C	.14	1.0							
3 C	.44	.34	1.0						
4 C	.02	-.08	.25	1.0					
5 C	.47	.38	.32	.07	1.0				
6 I	.70	.17	.58	.27	.69	1.0			
7 I	.92	.16	.41	.03	.59	.72	1.0		
8 I	.59	.16	.28	.04	.55	.68	.58	1.0	
Total Score	.79	.43	.71	.24	.77	.89	.82	.71	1.0
Mean	3.35	3.54	6.35	3.96	7.46	3.69	3.08	2.65	34.08
SD	2.147	1.966	3.351	1.344	2.777	2.108	2.183	2.165	12.576

---

1. C - Computer-generated item; I - Instructor-made item.

Table 4b

Intercorrelation Matrix-Test 2

Spring 1968 Sample

(N=21)

Variable	1	2	3	4	5	6	7	Total Score
Item 1 C[1]	1.0							
2 C	.41	1.0						
3. C	.40	.10	1.0					
4 C	.51	.37	.40	1.0				
5 C	.11	.40	.06	.38	1.0			
6 I	.15	.37	.14	.66	.04	1.0		
7 C	.60	.49	.10	.41	.46	.22	1.0	
Total Score	.65	.67	.44	.85	.55	.63	.72	1.0
Mean	3.95	2.52	4.00	8.10	8.86	7.67	6.29	41.38
SD	1.812	2.038	1.952	3.308	2.531	3.045	2.914	11.627

---

[1] C - Computer-generated item; I - Instructor-made item

Table 5

Item-test Correlation and Estimated Reliabilities:Spring-1968 Sample

	N	$\bar{r}_{gt}$[1]	$\bar{r}_{gs}$[2]	Estimated Test[3]	Reliability Item[4]
Test 1	8	.71	.63	.83	.38
Test 2	7	.66	.61	.77	.32
Instructor	4		.78	.72	.39
Computer	11		.67	.76	.22

1. $\bar{r}_{gt}$[1] - The average item-test score correlation for each test.
2. $\bar{r}_{gs}$ - The average item-sum score correlation where the sum score is the sum of the three tests.
3. - Coefficient alpha computed by analysis of variance.
4. - Estimated reliability per item.

difficult and somewhat more effective. Open-ended comments on these two questions suggested that knowledge of algebra makes this course much easier.

Responses to questions regarding course objectives were as follows:

3. Prior to each test you were given samples of statistics problems drawn from a defined universe of content.
   a. To what extent did you use these sample problems to study for the test?

      00% Used as only source
      62% Used more than any other source
      29% Used equally with other sources
      10% Used other sources more
      00% Did not use at all

   b. To what extent did you feel that the sample problems adequately defined what you had to learn in the course?

      86% Very valuable
      14% Somewhat valuable
      00% Of no value
      00% Somewhat detrimental
      00% Very detrimental

There was a significant increase in favorable responses by the spring-1968 sample as compared with the fall-1967 sample for both of the above items. This was possibly due to the fact that the sample items contained fewer flaws than in the first study. Also several of the notational problems noted earlier were corrected.

The next four items were concerned with a comparison between instructor made and computer generated items.

4. Some of the problems on your tests were generated by a computer from a defined universe of content.
   a. Did you find the computer generated problems more difficult or easier than instructor made problems?

      00% Very difficult
      24% Somewhat more difficult
      52% About the same
      24% Somewhat easier
      00% Much easier

b. Do you feel that your knowledge of statistics could be adequately tested using only test problems sampled by the computer?

10% All of the time
62% Most of the time
29% Some of the time
00% Little of the time
00% Very little of the time

c. How did the computer generated test problems compare with instructor problems in terms of fairness?

19% Very fair
14% Moderately fair
67% About the same
00% Moderately unfair
00% Very unfair

d. Do you think that it would be desirable to draw all test problems from a defined universe of content?

38% Very desirable
29% Somewhat desirable
19% Does not matter
10% Somewhat undesirable
05% Very undesirable

Again the responses of the spring-1968 sample were more positive on the above items compared to the fall-1967 sample. There was a significant shift on items 4a and 4b while the shifts on the other two items were not statistically significant. In general the spring-1968 sample reported that the computer generated items were less difficult and more fair than did the previous sample. This was probably due to corrections in the notation and wording of some of the item forms.

The results on student reaction to the technique suggested that as the bugs are more fully worked out of the item forms, student reaction will be very positive.

C. Discussions and Conclusions

The results of this study suggest that the reliability of computer generated test items is somewhat lower and more variable than instructor made items used for comparison. However, reliabilities for the computer items were in the acceptable range and it should be emphasized that the reliability results are not so discouraging as to suggest abandonment of the technique. Somewhat lower reliability may be the price one has to pay for the advantages of systematic sampling of items from a defined universe of content. Also further refinement of item forms could possibly correct this difficulty. In addition, computer items proved to be quite acceptable to students - especially in the second sample after improvements were made in the item forms. One can conclude that the results of the study were encouraging but there are a number of problems with the technique.

One major problem was the computer generating program. The program was quite adequate to implement the general strategy on which it was based but the strategy behind the program was probably faulty. Experience in attempting to construct item forms with the random replacement set approach suggests that this general strategy is very limited, because there are too many dependencies in a complex item form to easily represent the item form as a combination of fixed elements and random replacement sets. The program run time was very slow and the system proved to be cumbersome and difficult to debug. It appears from hindsight that what is needed is a data structure that is more ideally suited to the representation of data dependencies. Probably the most promising approach is to represent item-forms as tree structures. This data structure appears to offer maximum ability to represent dependencies in an item form.

Another severe limitation of the item generating program used in this study was that the correct answer to the item sentence is not provided by the program and to add this feature to the present program would be a formidable task. Representing an item form as a tree structure would simplify the task of generating the associated correct answer at the same time as the item sentence is composed.

It is concluded that, in spite of the difficulties, the possibilities for generating well defined classes of items by computer seem to be excellent. As more advanced data structures are devised the representation of item forms may be expected to become more flexible and refined. The payoff in terms of improvements in achievement testing will more than make the effort worthwhile.

REFERENCES

Hively II, Wells, Patterson, Harry L. and Page, Sara H. - Generalizability of performance of Job Corps Trainees on a universe defined-system of achievement tests in elementary mathematical calculation. Paper presented to American Educational Research Association, February, 1968.

Osburn, H. G. - Item sampling for achievement testing, Educational and Psychological Measurement 28, Spring, 1968.

APPENDIX A

BEHAVIOR LIST FOR ELEMENTARY STATISTICS

THE STUDENT IS ALLOWED TO USE THE TEXT AND ANY NOTES THAT HE DEEMS TO BE USEFUL. THE COMPETENT STUDENT IS EXPECTED TO BE ABLE TO DO THE FOLLOWING THINGS:

Pilot Project on Computer Generated Test Items
University of Houston

1. Sets, Relations, and Functions

   a. Perform set algebra on complicated expressions.
   b. Graph or list the elements in a set product.
   c. Graph or list the elements in a relation.
   d. List the elements in the domain or range of a function.
   e. Distinguish between functions and non-functions.
   f. Read functional notation.
   g. Distinguish between continuous and discrete functions.

2. Elementary Probability Theory

   a. List elements in finite sample spaces and subspaces of finite sample spaces.
   b. Compute the probability of events defined as subspaces of finite sample spaces.

3. Frequency Distributions

   a. Identify the upper and lower real limits, the upper and lower apparent limits, and the mid-points of class intervals.
   b. Construct a frequency polygon for a given distribution.
   c. Construct a histogram for a given distribution.
   d. Construct a cumulative frequency distribution.
   e. Compute probability of an event using frequency distribution.

4. Probability Distributions

   a. Convert a frequency distribution into a probability distribution.
   b. Construct a histogram from a probability distribution.
   c. Construct a relative frequency polygon for a discrete probability distribution.
   d. Compute probability of event using probability distribution.
   e. Compute the probability density of a simple continuous random variable.
   f. Graph a simple continuous density function.
   g. Compute areas of a simple continuous density function.

5. Conditional Probability

   a. Compute the probability of a joint event defined as overlapping subsets.
   b. Compute the conditional probability of an event.
   c. Apply Bayes Theorem.
   d. Identify a joint distribution as independent or dependent.

6. Permutations and Combinations

   a. Compute the number of sequences generated by N trials; k outcomes per trial.
   b. Compute the total number of possible orders of n objects.
   c. Compute the number of possible ordered combinations of x objects selected from n objects.
   d. Compute the number of possible combinations of x objects selected from n objects.

7. Binomial Distribution

   a. Compute the probability of x successes in a binomial distribution.
   b. Graph a binomial distribution.
   c. Compute the probability of some combination of successes when sampling from a binomial distribution.

8. Multinomial Distribution

   a. Compute the probability of obtaining a specific distribution when sampling with replacement from a given frequency distribution.

9. Hypergeometric Distribution

   a. Compute the probability of obtaining a specific distribution when sampling without replacement from a given frequency distribution.

10. Summation Notation

   a. Given a rectangular table sum any region as indicated by summation notation.

b. Given a rectangular table compute the sum of products.

c. Given three rectangular blocks of 1 digit numbers sum any combination of blocks or parts of blocks.

11. Descriptive Statistics

    a. Compute the mean and standard deviation of a frequency distribution.
    b. Compute the median and semi-interquartile range of a frequency distribution.
    c. Decide whether or not to use the mean or median to describe a distribution.
    d. Compute any arbitrary percentile point of a frequency distribution.
    e. Compute any arbitrary percentile rank of a frequency distribution.
    f. Transform raw scores to standard scores with arbitrary mean and standard deviation.

12. Algebra of Expectations

    a. Given a discrete probability distribution compute the expected value for any small power of x (the raw moments of x).
    b. Given a discrete probability distribution compute the lower order moments about the mean.
    c. Given two discrete probability distributions compute the expected value of a linear combination of X and Y.
    d. Compute the mean and variance of simple continuous probability distributions.

13. Point Estimation

    a. Identify the properties of a given estimator.
    b. Compute the standard error of the mean for any arbitrary distribution.
    c. Compute the sample size required for a given accuracy of estimation (law of large numbers).
    d. Estimate the standard error of the mean by pooling.

14. Normal Distributions

    a. Compute the density of X sampled from a normal distribution with known mean and variance.

b. Compute areas of a normal distribution with known mean and variance.

c. Compute the probabilities of specified values of linear combinations of independent normal variables.

d. Identify approximately normal distributions.

e. Compute areas using the normal approximation to the binomial distribution.

15. Hypothesis Testing

a. Given a verbal problem state the hypothesis together with its alternative and region of rejection.

b. Test an hypothesis about the mean of a normal distribution with known variance.

c. Compute the probability of a type I error made in rejecting the null hypothesis.

d. Compute confidence intervals for the population mean for normal distribution with known variance.

e. Compute the power of the test to reject the null hypothesis against a true alternative for normal distribution with known variance.

f. Test hypothesis about the difference between means of two independent samples for normal populations with known variance.

g. Compute the probability of a type I error made in rejecting the null hypothesis for two independent samples from a normal distribution with known variance.

h. Compute the confidence intervals for Mu_1 - Mu_2 given two independent samples from a normal distribution with known variance.

i. Compute the power of the test to reject the null hypothesis against a true alternative given two independent samples from a normal distribution with known variance.

j. Test hypothesis about the difference between means for two dependent samples from a normal distribution with known variance.

k. Compute the probability of a type I error made in rejecting the null hypothesis for two dependent samples from a normal distribution with known variance.

l. Compute the x percent conficence interval for Mu_1 - Mu_2 for two dependent samples from a normal distribution with known variance.

m. Compute the power of the test to reject the null hypothesis for two dependent samples from a normal distribution with known variance.

n. Compute the sample size required for a given power against a true alternative for two independent samples from a normal distribution with known variance.

16. Tests Using Student's t

a. Test hypothesis about the mean for normal distribution with unknown variance.

b. Compute the x percent confidence interval for the mean of a normal distribution with unknown variance.

c. Test null hypothesis for two independent samples from normal population with unknown variance.

d. Compute the x percent confidence interval for Mu_1 - Mu_2 for two independent samples from normal population with unknown variance.

e. Test the null hypothesis for two dependent samples from a normal population with unknown variance.

f. Compute the x percent confidence interval for Mu_1 - Mu_2 for two dependent samples from a normal population with unknown variance.

17. Correlation and Regression

a. Given the variances, means, and covariance for two variables, compute the standard score, deviation score and raw score regression equations.

b. Given the variances, means and covariance for two variables, compute the sample standard error of estimate, the proportion of variance accounted for or not accounted for and the population standard error of estimate.

c. Given the variances, means and covariance for two variables, test the hypothesis that the population correlation is zero, the population regression coefficient is zero and the population Y mean is some specified value.

d. Given the variances, means and covariance for two variables compute the x percent confidence interval for the population correlation, the regression coefficient and the Y mean.

e. List the assumptions made in testing the hypothesis that the population correlation, regression coefficient is zero or that the Y mean is some specified value.

f. Compute mean square linear regression, mean square deviations from linear regression and mean square error.

g. Given the correlation between the same two variables for two independent samples, test the hypothesis that the difference between the two population correlations is some specified value.

18. Chi Square Distributions

a. Compute the mean and variance of a Chi Square distributions with N degrees of freedom.

b. Test hypothesis about the variance of a normal population given a sample of size N.

c. Test hypothesis about the goodness of fit of a sample frequency distribution to a given distribution.

d. Test hypothesis about the goodness of fit of a sample frequency distribution to a normal distribution.

e. Test hypothesis of no association between two variables in a joint frequency distribution.

f. Test hypothesis of no association in a fourfold contingency table.

g. Test hypothesis of no association using Fisher's exact test.

h. Test hypothesis about correlated proportions in a fourfold table.

i. Compute the Phi coefficient on a fourfold table.

j. Compute Cramer's statistic for a rectangular table.

APPENDIX B

1. Sets, Relations, and Functions

a. Perform set algebra on complicated expressions.

001 Data: Four overlapping sets defined by listing elements.
Task: Tabulate the elements in a set expression.

002 Data: Four overlapping integer sets of the form (X/X is an integer, $a \leq X \leq b$).
Task: Tabulate the elements in a set expression.

003 Data: Three hypothetical overlapping sets with complete information on the number of elements.
Task: Compute the number of elements in a set expression.

004 Data: Two set expressions related by an equal sign.
Task: Prove that the left side is equal to the right side.

b. Graph or list the elements in a set product.

005 Data: Two non-overlapping sets defined by listing elements.
Task: Tabulate the elements in the set product.

006 Data: Two non-overlapping sets defined by listing elements.
Task: Graph the set product.

007 Data: Two non-overlapping sets of the form (X/X is an integer, $a \leq X \leq b$).
Task: Tabulate the elements in the set product.

008 Data: Two non-overlapping sets of the form (X/X is an integer, $a \leq X \leq b$).
Task: Graph the set product.

c. Graph or list the elements in a relation.

009 Data: Two non-overlapping sets defined by listing elements.
Task: Tabulate elements (in the set product) that have a common property.

010 Data: Two non-overlapping sets of the form (X/X is an integer, $a \leq X \leq b$), and a relations of the form $f(X)=g(Y)$.
Task: Tabulate the elements (in the set product) that satisfy the relation.

011 Data: Two non-overlapping sets of the form (X/X is an integer, $a \leq X \leq b$), and a relation of the form $f(X)=g(Y)$.
Task: Graph the elements (in the set product) that satisfy the relation.

d. List the elements in the domain or range of a function.

012 Data: Two non-overlapping sets of the form (X/X is an integer, $a<X<b$), and a function $Y = f(X)$.
Task: Tabulate the elements in the range or domain.

013 Data: Two sets defined by listing elements and a relation defined by a common property.
Task: Tabulate the elements in the range or domain.

e. Distinguish between functions and non-functions.

014 Data: Functions and non-functions.
Task: Is the relation a function and why or why not?

f. Read functional notation.

015 Data: A function with specified range and domain.
Task: Given a X value compute the corresponding $f(X)$ value.

g. Distinguish between continuous and discrete functions.

016 Data: Either a discrete or a continuous function of the form $Y = f(X)$ with a specified domain.
Task: Is the function discrete or continuous and why?

2. Elementary Probability Theory

a. List elements in finite sample spaces and subspaces of finite sample spaces.

017 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Tabulate all elements in the sample space.

018 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Compute the number of elements in the sample space.

019 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Tabulate the elements with a common property.

020 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Compute the number of elements with a common property.

021 Data: Hypothetical random process; n trials; k outcomes per trial.
Task: Compute the number of elements in a subset of the sample space.

022 Data: Hypothetical random process; n trials; k outcomes per trial.
Task: Tabulate the elements in a subset of the sample space.

b. Compute the probability of events defined as subspaces of finite sample spaces.

023 Data: Hypothetical random process; 1 trial; k outcomes per trial.
Task: Compute the probability of an event defined as a subset of the sample space.

024 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Compute the probability of an event defined as a subset of the sample spaces.

025 Data: Hypothetical random process; n trials; k outcomes per trial.
Task: Compute the probability of an event defined as a subset of the sample space.

3. Frequency Distributions.

a. Identify the upper and lower real limits, the upper and lower apparent limits, and the mid-points of class intervals.

026 Data: Frequency distribution.
Task:
- a. Compute the midpoints.
- b. Compute the upper and lower real limits.
- c. Identify the apparent limits of specified class intervals.

b. Construct a frequency polygon for a given distribution.

027 Data: Frequency distribution.
Task: Draw a frequency polygon for the given distribution.

028 Data: Rectangular table of 1-digit numbers.
Task: Draw a frequency polygon.

c. Construct a histogram for a given distribution.

029 Data: Frequency distribution.
Task: Draw a histogram for the given distribution.

030 Data: Rectangular table of 1-digit numbers.
Task: Draw a histogram.

d. Graph the cumulative frequency distribution.

031 Data: Frequency distribution.
Task: Graph the cumulative frequency distribution from the given distribution.

032 Data: Hypothetical frequency distribution.
Task: Graph the cumulative frequency distribution from the given distribution.

e. Compute probability of an event using frequency distribution.

033 Data: Hypothetical frequency distribution.
Task: Compute probability of an event.

4. Probability Distributions

a. Convert a frequency distributions into a relative frequency distribution.

034 Data: Empirical frequency distribution.
Task: Convert the given frequency distribution into a relative frequency distribution.

b. Construct a histogram from a relative frequency distribution.

035 Data: Relative frequency distribution.
Task: Draw a histogram for the given distribution.

c. Construct a relative frequency polygon for a relative frequency distribution.

036 Data: Relative frequency distribution.
Task: Draw a relative frequency polygon for the given distribution.

d. Compute the probability of even using probability distribution.

037 Data: Hypothetical probability distribution.
Task: Compute the probability of an event.

e. Compute the probability density of a simple continuous random variable.

038 Data: Equation for a straight line density function.
Task: Compute $f(X_0)$ for a given X_0.

f. Graph a simple continuous density function.

039 Data: Equation for a straight line density function.
Task: Graph the given function.

g. Compute areas of a simple continuous density function.

040 Data: Equation for a straight line density function.
Task: Compute the probability that X is in a specified region.

5. Conditional Probability

a. Compute the probability of a joint event defined as overlapping subsets.

041 Data: Three overlapping hypothetical sets.
Task: Compute the probability that a randomly selected element is from a specified subset.

042 Data: Four overlapping sets defined by listing elements.
Task: Compute the probability that a randomly selected element is from a specified subset.

043 Data: Three. overlapping sets of the form (X/X is an integer, $a \leq X \leq b$).
Task: Compute the probability that a randomly selected element is from a specified subset.

b. Compute the conditional probability of an event.

044 Data: Frequency distribution.
Task: Given that X is in a region, what is the probability that X is in a subregion?

045 Data: Probability distribution.
Task: Given that X is in a region, what is the probability that X is in a subregion?

046 Data: Joint frequency distribution.
Task: Given that X is in a region, compute the probability that Y is in a specified region.

047 Data: Joint probability distribution.
Task: Given that X is in a region, compute the probability that Y is in a specified region.

048 Data: N ordered pairs (X,Y).
Task: Given that X is in a region, compute the probability that Y is in a specified region.

049 Data: Hypothetical frequency distribution.
Task: Given that X is in a region, compute the probability that X is in a subregion.

050 Data: Hypothetical probability distribution.
Task: Given that X is in a region, compute the probability that X is in a specified subregion.

c. Apply Bayes Theorem.

051 Data: Hypothetical data implying p(A), p(B/A), and p(B).
Task: Compute p(A/B).

d. Identify a joint distribution as independent or dependent.

052 Data: Joint frequency distribution.
Task: Are X and Y independent? why or why not?

053 Data: Joint relative frequency distribution
Task: Are X and Y independent? why or why not?

6. Permutations and Combinations

a. Compute the number of sequences generated by N trials; k outcomes per trial.

054 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Compute the total number of possible sequences.

055 Data: Hypothetical random process; n trials; k outcomes per trial.
Task: Compute total number of possible sequences.

b. Compute the total number of possible orders of n objects.

056 Data: Hypothetical random process; permutations on n objects.
Task: Compute the total number of possible orders.

c. Compute the number of possible ordered combinations of x objects selected from n objects.

058 Data: Hypothetical random process; n objects taken x at a time.
Task: Compute the total number of possible combinations.

7. Binomial Distribution

a. Compute the probability of x successes in sampling n trials from a binomial distribution.

059 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Compute the probability of exactly x successes where the probability of a success is 1/k.

060 Data: Hypothetical random process; n trials; k outcomes per trial.
Task: Compute the probability of exactly x successes where the probability of a success is 1/k.

061 Data: Sampling with replacement from a hypothetical probability distribution; success defined.
Task: Compute the probability of exactly x successes.

062 Data: Sampling with replacement from an hypothetical frequency distribution; success defined.
Task: Compute the probability of exactly x successes.

063 Data: Sampling with replacement from a frequency distribution; success defined.
Task: Compute the probability of exactly x successes.

064 Data: Sampling with replacement from a probability distribution; success defined.
Task: Compute the probability of exactly x successes.

b. Graph a binomial distribution.

065 Data: Sampling three observations with replacement from a hypothetical probability distribution; success defined.
Task: Graph the theoretical distribution of successes for 200 repetitions.

066 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Graph the distribution of successes for 100 repetitions where the probability of a success is 1/k.

067 Data: Sampling three observations with replacement from a hypothetical frequency distribution; success defined.
Task: Graph the distribution of successes for 100 repetitions.

068 Data: Three repetitions of a hypothetical random process; 1 trial; k outcomes per trial.
Task: Graph the theoretical distribution of successes for 500 repetitions where the probability of success is 1/k.

c. Compute the probability of some combination of successes when n trials are sampled from a binomial distribution.

069 Data: Hypothetical random process; 2 trials; k outcomes per trial.
Task: Compute the probability that x is some specified range of values where the probability of success is 1/k.

070 Data: Hypothetical random process; n trials; k outcomes per trial.
Task: Compute the probability that x is some specified range of values where the probability of success is 1/k.

071 Data: Sampling with replacement from a hypothetical probability distribution.
Task: Compute the probability that x is some specified range of values.

072 Data: Sampling with replacement from a hypothetical frequency distribution.
Task: Compute the probability that x is some specified range of values.

073 Data: Sampling with replacement from a frequency distribution.
Task: Compute the probability that x is some specified range of values.

074 Data: Sampling with replacement from a probability distribution.
Task: Compute the probability that x is some specified range of values.

8. Multinomial Distribution

a. Compute the probability of obtaining a specific distribution when sampling with replacement from a given frequency distribution.

075 Data: Sampling with replacement from a hypothetical probability distribution.
Task: Compute the probability of obtaining a specified distribution.

076 Data: Sampling with replacement from a hypothetical probability distribution.
Task: Compute the probability of obtaining a specified distribution.

077 Data: Sampling with replacement from a probability distribution.
Task: Compute the probability of obtaining a specified distribution.

078 Data: Sampling with replacement from a frequency distribution.
Task: Compute the probability of obtaining a specified distribution.

9. Hypergeometric Distribution.

a. Compute the probability of obtaining a specific distribution when sampling without replacement from a given frequency distribution.

079 Data: Sampling without replacement from a hypothetical probability distribution.
Task: Compute the probability of obtaining a specified distribution.

080 Data: Sampling without replacement from a hypothetical frequency distribution.
Task: Compute the probability of obtaining a specified distribution.

081 Data: Sampling without replacement from a probability distribution.
Task: Compute the probability of obtaining a specified distribution.

082 Data: Sampling without replacement from a frequency distribution.
Task: Compute the probability of obtaining a given distribution.

10. Summation Notation

a. Given a rectangular table sum any region as indicated by summation notation.

083 Data: Rectangular table of 1 digit numbers.
Task: Compute sum x(i,a) where i runs from 1 to C.

084 Data: Rectangular table of 1 digit numbers.
Task: Compute sum x(i,j) where i runs from 1 to P and j runs from 1 to Q.

085 Data: Rectangular table of 1 digit numbers.
Task: Compute sum x(i,j) where i runs from 1 to C and j runs from 1 to R and i is always less than j.

b. Given a rectangular table compute the sum of products.

086 Data: Rectangular table of 1 digit numbers.
Task: Compute the sum x(i,a) x(i,b) where i runs from 1 to C.

087 Data: Rectangular table of 1 digit numbers.
Task: Compute the sum over j of the quantities (sum x(i,j) where i runs from 1 to C) squared.

088 Data: Rectangular table of 1 digit numbers.
Task: Compute sum x(i,a) x(i,) where i runs from 1 to C and j runs from 1 to 2.

c. Given three rectangular blocks of 1 digit numbers sum any combination of blocks or parts of blocks.

089 Data: Three rectangular blocks of 1 digit numbers.
Task: Compute sum x(i,j,a) where i runs from 1 to C and j runs from 1 to R.

090 Data: Three rectangular blocks of 1 digit numbers.
Task: Compute sum x(k,j,k) where i runs from 1 to Q and j runs from 1 to P and k runs from 1 to S.

11. Descriptive Statistics

a. Compute the mean and standard deviation of a frequency distribution.

091 Data: Frequency distribution.
Task: Compute the mean and standard deviation of the given distribution.

092 Data: Rectangular table of 1 digit numbers.
Task: Compute the mean and standard deviation of the given numbers.

b. Compute the median and semi-interquartile range of a frequency distribution.

093 Data: Frequency Distribution.
Task: Compute the median and semi-interquartile range of the distribution.

094 Data: Rectangular table of 1 digit numbers.
Task: Compute the median and semi-interquartile range of the numbers.

c. Decide whether or not to use the mean or median to describe the central tendency of a distribution.

095 Data: List of hypothetical distributions; some badly shewed.
Task: Should the mean or median be used to describe the distribution and why?

d. Compute any arbitrary percentile point of a frequency distribution.

096 Data: Frequency distribution.
Task: Compute the xth percentile point.

097 Data: Rectangular table of 1 digit numbers.
Task: Compute the xth percentile point of the numbers.

e. Compute any arbitrary percentile rank of a frequency distribution.

098 Data: Frequency distribution.
Task: Compute the percentile rank corresponding to the xth score.

099 Data: Rectangular table of 1 digit numbers.
Task: Compute the percentile rank corresponding to the xth score.

f. Transform raw scores to standard scores with arbitrary mean and standard deviation.

100 Data: Hypothetical normal distribution with known mean and variance.
Task: Given an x value compute the derived standard score equivalent.

101 Data: N repetitions of a hypothetical random process; 1 trial; k outcomes per trial where the probability of a success is 1/k.
Task: Given an x value, compute the standard score equivalent.

12. Algebra of Expectations

a. Given a discrete probability distribution compute the expected value for any small power of x (the raw moments of x).

102 Data: Probability distribution.
Task: Compute $E(X)$, $E(X^2)$, or $E(X^3)$.

b. Given a discrete probability distribution compute the lower order moments about the mean.

103 Data: Probability distribution.
Task: Compute $X(X-E(X))^2$ or $E(X-E(X))^3$

c. Given two discrete probability distributions compute the expected value of a linear combination of X and Y.

104 Data: Two probability distributions.
Task: Compute E(Z) where Z = aX + bY + c.

d. Compute the mean and variance of simple continuous probability distributions.

105 Data: Straight line density function.
Task: Compute the mean and variance of X.

13. Point Estimation

a. Identify the properties of a given estimator.

106 Data: A sample statistic from the list: mean, standard deviation, NS/(N-1), correlation, median.
Task: Is the given estimator
- a. consistent
- b. sufficient
- c. unbiased
- d. efficient?

b. Compute the standard error of the mean for any arbitrary distribution.

107 Data: Sampling with replacement from a frequency distribution with reported mean and variance.
Task: Compute the standard error of the mean for samples of size N.

108 Data: Sampling with replacement from a relative frequency distribution with reported mean and variance.
Task: Compute the standard error of the mean for samples of size N.

109 Data: Hypothetical random process; 1 trial; k outcomes per trial; N repetitions where the probability of a success is 1/k.
Task: Compute the standard error of the mean for samples of size N.

c. Compute the sample size required for a given accuracy of estimation (law of large numbers).

110 Data: Sampling with replacement from a frequency distribution.
Task: Compute the needed sample size such that the probability is greater than or equal to x that the sample mean is within y standard deviations of the true mean.

111 Data: Sampling with replacement from a relative frequency distribution.
Task: Compute the needed sample size such that the probability is greater than or equal to x that the sample mean is within y standard deviations of the true mean.

d. Estimate the standard error of the mean by pooling.

112 Data: Given two frequency distributions.
Task: Estimate the standard error of the mean assuming that both samples came from the same population.

113 Data: Given two relative frequency distributions.
Task: Estimate the standard error of the mean assuming that both samples came from the same population.

14. Normal Distributions

a. Compute the density of X sampled from a normal distribution with known mean and variance.

114 Data: "Given a normal distribution with mean Mu and variance Var."
Task: Compute the probability density of X_1, X_2, etc.

b. Compute areas of a normal distribution with known mean and variance.

115 Data: Hypothetical normal distribution with known mean and variance.
Task: Compute the probability that a randomly selected sample point is in a specified area.

116 Data: "Given a normal distribution with mean Mu and variance Var."
Task: Compute the probability that a randomly selected sample point is in a specified area.

117 Data: Hypothetical normal distribution with known mean and variance.
Task: Given that N cases are randomly sampled, compute the probability that the sample mean is in a specified area.

c. Compute the probabilities of specified values of linear combinations of independent normal variables.

118 Data: Hypothetical normal distribution with known mean and variance.
Task: If X_1 and X_2 are randomly sampled from the distribution and $Y = aX_1 + bX_2$ compute the probability that y is some specified range of values.

118 Data: "X is a normally distributed random variable with mean Mu and variance Var. Y is a normally distributed variable with mean Mu and variance Var. Z = aX + bY."
Task: Compute the probability that Z is some specified range of values.

d. Identify approximately normal distributions.

120 Data: List of distributions some approximately normal and some not.
Task: Identify the distributions that are approximately normal and give the reason why.

e. Compute areas using the normal approximation to the binomial distribution.

121 Data: N repetitions of hypothetical random process; 1 trial; k outcomes per trial.
Task: Compute the probability of a specified range of successes where the probability of a success is 1/k.

122 Data: Large sample (sampling with replacement) from a hypothetical probability distribution.
Task: Compute the probability of a specified range of successes where the probability of a success is 1/k.

123 Data: Large sample (sampling with replacement) from a hypothetical probability distribution.
Task: Compute the probability of a specified range of successes.

124 Data: Large sample (sampling with replacement) from a hypothetical frequency distribution.
Task: Compute the probability of a specified range of successes.

15. Hypothesis Testing

a. Given a verbal problem state the hypothesis together with its alternative and region of rejection.

125 Data: Hypothetical verbal problems.
Task: State the hypothesis; its alternative and region of rejection.

b. Test an hypothesis about the mean of a normal distribution with known variance.

126 Data: Hypothetical normal distribution with known variance; sample size; sample mean; alpha.
Task: Test hypothesis that population mean is some specified value (two-tail).

127 Data: Hypothetical normal distribution with known variance; sample size; sample mean; alpha.
Task: Test hypothesis that population mean is greater than (less than) some specified value.

c. Compute probability of a type I error in rejecting the null hypothesis.

128 Data: Hypothetical normal distribution with known variance; sample size; sample mean.
Task: Compute probability of a type I error in rejecting the hypothesis that population mean is some specified value (two-tail).

129 Data: Hypothetical normal distribution with known variance; sample size; sample mean.
Task: Compute probability of a type I error in rejecting the hypothesis that population mean is greater than (less than) some specified value (one-tail).

d. Compute confidence intervals for the population mean for normal distribution with known variance.

130 Data: Hypothetical normal distribution with known variance; sample size; sample mean.
Task: Compute the x percent confidence interval for the population mean.

e. Compute the power of the test to reject the null hypothesis against a true alternative for normal distribution with known variance.

131 Data: Hypothetical normal distribution with known variance; sample size; sample mean; alpha.
Task: Compute the power of the test to reject the null hypothesis against a true alternative.

132 Data: Hypothetical normal distribution with known variance; sample size; sample mean.
Task: Plot the operating characteristic curve for a given alpha.

133 Data: Hypothetical normal distribution with known variance; sample size; sample mean.
Task: Compute the probability of a type II error against a true alternative.

f. Test hypothesis about the difference between means of two independent samples for normal populations with known variance.

134 Data: Two independent samples from a hypothetical normal distribution with known variance; sample sizes; sample means; alpha.
Task: Test the hypothesis that $Mu_1 - Mu_2 = 0$.

g. Compute probability of a type I error made in rejecting the null hypothesis for two independent samples from a normal distribution with known variance.

135 Data: Two independent samples from a hypothetical normal population with known variance; sample sizes; sample means; alpha.
Task: Compute probability of a type I error made in rejecting the hypothesis that $Mu_1 - Mu_2 = 0$.

h. Compute the confidence intervals for $Mu_1 - Mu_2$ given two independent samples from a normal distribution with known variance.

136 Data: Two independent samples from a hypothetical normal distribution; sample size; sample means.
Task: Compute the x percent confidence interval for $Mu_1 - Mu_2$.

i. Compute the power of the test to reject the null hypothesis against a true alternative given two independent samples from a normal distribution with known variance.

137 Data: Two independent samples from a hypothetical normal distribution with known variance; samples sizes; alpha.
Task: Compute the power of the test to reject the null hypothesis against a true alternative.

j. Test hypothesis about the difference between means for two dependent samples from a normal distribution with known variance.

138 Data: Two dependent samples from a normal distribution with known variance; sample sizes; sample means; correlation; alpha.
Task: Test hypothesis that $Mu_1 - Mu_2 = 0$.

k. Compute probability of a type I error made in rejecting the null hypothesis for two dependent samples from a normal distribution with known variance.

139 Data: Two dependent samples from a normal distribution with known variance; sample sizes; sample means; correlation; alpha.
Task: Compute probability of a type I error in rejecting the hypothesis that $Mu_1 - Mu_2 = 0$.

l. Compute the x percent confidence interval for Mu_1 - Mu_2 for two dependent samples from a normal distribution with known variance.

140 Data: Two dependent samples from hypothetical normal distribution; sample sizes; sample means; correlation.
Task: Compute the x percent confidence interval for Mu_1 - Mu_2.

m. Compute the power of the test to reject the null hypothesis for two dependent samples from a normal distribution with known variance.

141 Data: Two dependent samples from a normal distribution with known variance; sample sizes; correlation; alpha.
Task: Compute the power of the test to reject the null hypothesis against a true alternative.

n. Compute the sample size required for a given power against a true alternative for two independent samples from a normal distribution with known variance.

142 Data: Two independent samples from a normal distribution with known variance.
Task: Compute the sample size required for a given alpha and beta against a true alternative.

16. Tests Using Student's t

a. Test hypothesis about the man for normal distribution with unknown variance.

143 Data: Hypothetical normal distribution with unknown variance; sample size; sample SD; sample mean; alpha.
Task: Test hypothesis that population mean is some specified value (two-tail).

144 Data: Hypothetical normal distribution with unknown variance; sample size; sample SD; sample mean; alpha.
Task: Test hypothesis that population mean is greater than (less than) some specified value (one-tail).

b. Compute the x percent confidence interval for the mean of a normal distribution with unknown variance.

145 Data: Hypothetical normal distribution with unknown variance; sample size; sample SD; sample mean.
Task: Compute the x percent confidence interval for the mean.

c. Test null hypothesis for two independent samples from normal population with unknown variance.

146 Data: Two independent samples from normal population with unknown variance; sample sizes; sample SDs; sample means; alpha.
Task: Test hypothesis that $Mu_1 - Mu_2 = 0$.

d. Compute the x percent confidence interval for $Mu_1 - Mu_2$ for two independent samples from normal population with unknown variance.

147 Data: Two independent samples from normal population with unknown variance; sample sizes; sample SDs; sample means.
Task: Compute the x percent confidence interval for $Mu_1 - Mu_2$.

e. Test the null hypothesis for two dependent samples from a normal population with unknown variance.

148 Data: Two dependent samples from hypothetical normal distribution; sample sizes; sample SDs; sample means.
Task: Test hypothesis that $Mu_1 - Mu_2 = 0$.

f. Compute the x percent confidence interval for $Mu_1 - Mu_2$ for two dependent samples from a normal population with unknown variance.

149 Data: Two dependent samples from hypothetical normal population; sample sizes; sample SDs; sample means; correlation.
Task: Compute the x percent confidence interval.

17. Correlation and Regression

a. Given the variances, means and covariance for two variables, compute the standard score, deviation score and raw score regression equations.

150 Data: Hypothetical correlated variables; sample sizes; means; variances; covariances.
Task: Compute the standard score regression equation. Given z_x compute the corresponding z_y.

151 Data: Hypothetical correlated variable; sample size; means; variances; covariances.
Task: Compute the deviation score regression equation. Given x compute the corresponding y.

152 Data: Hypothetical correlated variables; sample size; means; variances; covariances.
Task: Compute the raw score regression equation. Given X compute the corresponding Y.

b. Given the variances, means, and covariance for two variables, compute the sample standard error of estimate, the proportion of variance accounted for or not accounted for and the population standard error of estimate.

153 Data: Hypothetical correlated variables; sample size; means; variances; covariances.
Task: Compute the proportion of variance in Y accounted for by X.

154 Data: Hypothetical correlated variables; sample size; means; variances; covariances.
Task: Compute the sample standard error of estimate.

155 Data: Hypothetical correlated variables; sample size; means; variances; covariances.
Task: Compute the estimated population standard error of estimate.

c. Given the variances, means and covariance for two variables, test the hypothesis that the population correlation is zero, the population regression coefficient is zero and the population Y mean is some specified value.

156 Data: Hypothetical correlated variables; sample size; means; variances; covariance; alpha.
Task: Test hypothesis that the population correlation is zero.

157 Data: Hypothetical correlated variables; sample size; means; variances; covariance; alpha.
Task: Test hypothesis that the population regression coefficient is zero.

158 Data: Hypothetical correlated variables; sample size; means; variances; covariance; alpha.
Task: Test hypothesis that the population Y mean is some specified value.

d. Given the variances, means and covariance for two variables, compute the x percent confidence interval for the population correlation, the regression coefficient and the Y mean.

159 Data: Hypothetical correlated variables; sample size; means; variances; covariance.
Task: Compute the x percent confidence interval for the population correlation coefficient.

160 Data: Hypothetical correlated variables; sample size; means; variances; covariance.
Task: Compute the x percent confidence interval for the population regression coefficient.

161 Data: Hypothetical correlated variables; sample size; means; variances, covariance.
Task: Compute the x percent confidence interval for the population y mean.

e. List the assumptions made in testing the hypothesis that the population correlation, regression coefficient is zero or that the Y mean is some specified value.

162 Data: Hypothetical normal variables.
Task: List assumptions involved in testing the hypothesis that the population correlation is zero.

163 Data: Hypothetical normal variables.
Task: List assumptions involved in testing the hypothesis that the population regression coefficient is zero.

164 Data: Hypothetical normal variables.
Task: List assumptions involved in testing the hypothesis that the population Y mean is some specified value.

f. Compute mean square linear regression, mean square deviations from linear regression and mean square error.

165 Data: Ordered pairs (x,y).
Task: Compute
a. Mean square linear regression.
b. Mean square deviation from linear regression.
c. Mean square error.

166 Data: Ordered pairs (x,y).
Task: Test hypothesis that the regression is linear.

g. Given the correlation between the same two variables for two independent samples, test the hypothesis that the difference between the two population correlations is some specified value.

167 Data: Hypothetical correlation between X and Y for two independent samples; sample sizes.
Task: Test the hypothesis that the difference between the two population correlations is some specified value.

18. Chi Square Distributions

a. Compute the mean and variance of a Chi Square distribution with N degrees of freedom.

168 Data: "Suppose that X is distributed as Chi Square with N degrees of freedom."
Task: Compute the mean and variance of X.

169 Data: Hypothetical normal distribution with known variance.
Task: Compute the mean and variance of Q over all samples of size N if Q - Sum (X - XBAR)^2/sigma.

b. Test hypothesis about the variance of a normal population given a sample of size N.

170 Data: Hypothetical normal population with unknown mean and variance; sample size; sample SD.
Task: Test the hypothesis that sigma is some specified value.

171 Data: Hypothetical normal population with unknown mean and variance; sample size; sample SD.
Task: Compute the x percent confidence interval for sigma.

c. Test hypothesis about the goodness of fit of a sample frequency distribution to a given distribution.

172 Data: Frequency distribution.
Task: Test hypothesis of goodness of fit to a theoretical distribution.

173 Data: A die is tossed N times (N large).
Task: Test the hypothesis that the die is fair.

d. Test hypothesis about the goodness of fit of a sample frequency distribution to normal distribution.

174 Data: Frequency distribution.
Task: Test hypothesis of goodness of fit to normal distribution.

e. Test hypothesis of no association between two variables in a joint frequency distribution

175 Data: Joint frequency distribution.
Task: Test hypothesis of no association.

f. Test hypothesis of no association in a fourfold contingency table.

176 Data: Fourfold contingency table.
Task: Test hypothesis of no association.

g. Test hypothesis of no association using Fisher's exact table.

177 Data: Fourfold frequency table.
Task: Test hypothesis of no association using Fisher's exact test.

h. Test hypothesis about correlated proportions in a fourfold table.

178 Data: Fourfold table with two observations per subject.
Task: Test hypothesis of no change in proportion, positive or negative.

i. Compute the Phi coefficient on a fourfold table.

179 Data: Fourfold table.
Task: Compute Phi.

j. Compute Cramer's statistic for a rectangular table.

180 Data: Joint distribution.
Task: Compute Cramer's statistic.

APPENDIX C

Psy. 492 - Elementary Statistics

Test 1 - Fall 1967

1. GROUP THE FOLLOWING DATA USING INTERVALS OF WIDTH 1 AND CONSTRUCT A HISTOGRAM.

8 5 7 8 8 8
8 4 5 8 5 1
4 6 3 6 7 6
1 5 2 5 1 1
1 4 8 7 6 3
8 7 1 8 2 5

2. STATE WHETHER THE MEAN OR THE MEDIAN SHOULD BE USED TO DESCRIBE THE DISTRIBUTING LISTED BELOW AND GIVE THE REASON FOR YOUR ANSWER.

   A. DISTRIBUTION OF REACTION TIMES.

   B. DISTRIBUTION OF AUTOMOBILE ACCIDENTS OVER A ONE YEAR PERIOD.

   C. SCORES ON THE WECHSLER ADULT INTELLIGENCE SCALE.

3. GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION

19-22	5
15-18	25
11-14	40
07-10	25
03-06	5

COMPUTE THE 83 PERCENTILE POINT OF THE DISTRIBUTION.

4. GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION.

19-21	1
16-18	7
13-15	17
10-12	25
07-09	17
04-06	7
01-03	1

COMPUTE THE MEDIAN AND SEMI-INTERQUARTILE RANGE OF THE ABOVE DISTRIBUTION.

5. GRAPH THE CUMULATIVE FREQUENCY DISTRIBUTION FROM THE FOLLOWING DISTRIBUTION.

11-12	5
09-10	22
07-08	50
05-06	48
03-04	22
01-02	4

6. TEN STUDENTS WERE ADMINISTERED A VERBAL REASONING TEST AND A SPATIAL RELATIONS TEST WITH THE FOLLOWING RESULTS:

(SUM X(I) I=1,N) = 48

(SUM Y(I) I=1,N) = 41

(SUM X(I)X(I) I = 1,N) = 517

(SUM Y(I)Y(I) I = 1,N) = 521

(SUM X(I)Y(I) I = 1,N) = 240

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE VERBAL REASONING TEST AND Y(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. COMPUTE THE PROPORTION OF VARIANCE IN Y ACCOUNTED FOR BY X.

7. ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 119

MEAN Y = 68

VARIANCE X = 88

VARIANCE Y = 26

COVARIANCE XY = 21

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE JOB PERFORMANCE RATING ON THE ITH INDIVIDUAL. SET UP THE RAW SCORE REGRESSION EQUATION FOR PREDICTING Y FROM X. SAM HAS AN X SCORE OF 111. WHAT WOULD BE HIS PREDICTED RAW SCORE ON Y?

Psy. 492 - Elementary Statistics

Test 2 - Fall 1967

1. SUPPOSE THAT A WHITE DIE AND A BLACK DIE ARE TOSSED. COMPUTE THE NUMBER OF OUTCOMES IN WHICH THE SUM OF THE SPOTS IS GREATER THAN 6.

2. SUPPOSE THAT 3 COINS ARE TOSSED ONE TIME. COMPUTE THE PROBABILITY OF OBTAINING EXACTLY ONE HEAD.

3. GIVEN THE FOLLOWING HYPOTHETICAL JOINT DISTRIBUTION.

09-10	0	2	4	2	0
07-08	2	14	22	14	2
05-06	4	22	36	22	4
03-04	2	14	22	14	2
01-02	0	2	4	2	0

WHERE X IS THE VARIABLE ALONG THE ABSCISSA AND Y IS THE VARIABLE ALONG THE ORDINATE. IF ONR PAIR OF NUMBERS IS RANDOMLY SELECTED FROM THIS DISTRIBUTION AND X IS GREATER THAN 6 COMPUTE THE PROBABILITY THAT Y IS AT LEAST 5.

4. A BIPARTISAN COMMITTEE CONTAINS 9 REPUBLICANS, 7 DEMOCRATS AND 8 INDEPENDENTS. SUPPOSE THAT 2 MEMBERS ARE SELECTED AT RANDOM (WITH REPLACEMENT) FROM THE COMMITTEE. COMPUTE THE PROBABILITY THAT AT MOST 1 OF THE MEMBERS SELECTED IS A REPUBLICAN.

5. A HIGH SCHOOL PRINCIPAL IS FACED WITH A DECISION OF WHETHER OR NOT TO INSTITUTE AN ENRICHMENT PROGRAM IN THE 12TH GRADE CLASSES. HE HAS REASON TO BELIEVE THAT THE ADVANCE IQ OF THE 12TH GRADERS IN HIS SCHOOL IS 110 OR BETTER, BUT HE ISN'T SURE. HE ASKS THE SCHOOL PSYCHOLOGIST TO MAKE A TEST OF THIS HYPOTHESIS. THE PSYCHOLOGIST DRAWS A RANDOM SAMPLE OF 87 STUDENTS FROM THE 12TH GRADE CLASSES AND HE FOUND THAT THE MEAN IQ OF THE SAMPLE WAS 113 AND THE STANDARD DEVIATION WAS 9. IF THE PSYCHOLOGIST SET ALPHA AT .05, AND USED A $\bar{z}$ TEST DID HE ACCEPT OR REJECT THE HYPOTHESIS? SHOW YOUR WORK. (THIS QUESTION IS WORTH FIVE POINTS).

6.A. IT CAN BE ASSUMED THAT OVER THE GENERAL POPULATION THE STANDARD DEVIATION OF THE WECHSLER TEST IS 15. A HIGH SCHOOL PRINCIPAL WISHED TO TEST THE HYPOTHESIS THAT HIS 12TH GRADE STUDENTS WERE JUST AVERAGE ON WECHSLER INTELLIGENCE TEST i.e. Mu$_x$ = 100. HE ASKED THE SCHOOL PSYCHOLOGIST TO MAKE A TEST OF THIS HYPOTHESIS. THE PSYCHOLOGIST TOOK A RANDOM SAMPLE OF 82 12TH GRADERS AND FOUND THEIR MEAN IQ TO BE 102. IF HE SET ALPHA AT .05 DID HE ACCEPT OR REJECT THE HYPOTHESIS? (5 POINTS)

B. COMPUTE THE PROBABILITY OF A TYPE II ERROR (BETA) IF THE TRUE MEAN IQ OF ALL THE 12TH GRADERS WAS 105? (10 POINTS)

7. TWO GROUPS OF SCHOOL CHILDREN WERE TAUGHT READING -- THE CONTROL GROUP WAS TAUGHT WITH THE PHONICS METHOD AND THE EXPERIMENTAL GROUP WAS TAUGHT WITH THE WORD RECOGNITION METHOD. THERE WERE 20 STUDENTS IN THE CONTROL GROUP AND 25 STUDENTS IN THE EXPERIMENTAL GROUP. THE INVESTIGATOR WISHED TO USE A "t" TEST OF THE HYPOTHESIS OF NO DIFFERENCE BETWEEN THE TWO GROUPS CONTROLLING ALPHA AT .05. HE ADMINISTERED A READING ACHIEVEMENT TEST TO BOTH GROUPS AND OBTAINED THE FOLLOWING DATA:

	MEAN	STANDARD DEVIATION
CONTROL	30	16
EXPERIMENTAL	36	11

DID HE ACCEPT OR REJECT THE HYPOTHESIS? SHOW YOUR WORK (THE QUESTION IS WORTH 10 POINTS).

HINT: $\sigma_x = \sqrt{\frac{\Sigma x^2}{N}}$

8.

NATURE OF TEST	POPULATION STANDARD DEVIATION	HYPOTHESIS TO BE TESTED	ALPHA	N	REGION OF REJECTION
EXACT	KNOWN	$H_o: Mu_x = 50; H_1: Mu_x \neq 50$	.05	100	
EXACT	KNOWN	$H_o: Mu_x \geq 50; H_1: Mu_x < 50$	.05	100	
APPROXIMATE	UNKNOWN	$H_o: Mu_x = 50; H_1: Mu_x \neq 50$	.01	100	
EXACT	UNKNOWN	$H_o: Mu_x = 50; H_1: Mu_x \neq 50$	.05	100	
EXACT	UNKNOWN	$H_o: (Mu_{x_1} - Mu_{x_2}) = 0; H_1 (Mu_{x_1} - Mu_{x_2}) \neq 0$	.01	$N_1 = 50$ $N_2 = 25$	
EXACT	KNOWN	$H_o: (Mu_{x_1} - Mu_{x_2}) \geq 0; H_1: (Mu_{x_1} - Mu_{x_2}) < 0$	.01	$N_1 = 50$ $N_2 = 50$	
APPROXIMATE	UNKNOWN	$H_o: (Mu_{x_1} - Mu_{x_2}) = 0; H_1: (Mu_{x_1} - Mu_{x_2}) \neq 0$	.02	$N_1 = 50$ $N_2 = 50$	

THIS QUESTION IS WORTH 14 POINTS - 2 POINTS PER ITEM.

Psy. 492 - Elementary Statistics

Final Exam - Fall 1967

1. A SAMPLE OF 100 DEMOCRATS, 100 REPUBLICANS, 50 INDEPENDENTS WERE SURVEYED REGARDING THEIR OPINIONS OF PRESIDENT JOHNSON. IT WAS FOUND THAT 65 DEMOCRATS, 35 REPUBLICANS, AND 25 INDEPENDENTS THOUGHT THAT PRESIDENT JOHNSON WAS DOING A GOOD JOB. TEST THE HYPOTHESIS OF NO ASSOCIATION BETWEEN POLITICAL AFFILIATION AND OPINION OF PRESIDENT JOHNSON.

2. THE RELIABILITY COEFFICIENT FOR A CERTAIN TEST IS .84 AND THE STANDARD DEVIATION IS 20.
   A. COMPUTE THE STANDARD ERROR OF MEASUREMENT FOR THIS TEST.
   B. WHAT IS THE TRUE VARIANCE FOR THIS TEST?
   C. WHAT WOULD BE THE ESTIMATED RELIABILITY COEFFICIENT IF THE TEST IS DOUBLED IN LENGTH?

3. A CLERICAL APTITUDE TEST HAS A COEFFICIENT OF PREDICTIVE VALIDITY OF .40 FOR CLERK-TYPIST POSITIONS. THE RELIABILITY COEFFICIENT OF THE TEST IS .64.

   A. WHAT IS THE ESTIMATED COEFFICIENT OF PREDICTIVE VALIDITY FOR THIS TEST, IF THE TEST WERE PERFECTLY RELIABLE?

4. JOHN TOOK A 100 ITEM 4-ALTERNATIVE MULTIPLE CHOICE TEST. HE ATTEMPTED 90 ITEMS AND HIS ANSWERS WERE CORRECT ON 69 ITEMS. WHAT WOULD BE HIS TEST SCORE CORRECTED FOR GUESSING BY THE STANDARD FORMULA?

5. SUPPOSE THAT A WHITE DIE AND A BLACK DIE ARE TOSSED. COMPUTE THE PROBABILITY THAT EXACTLY ONE DIE TURNS UP THE 2 SPOT.

6. GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION

16-17	2
14-15	9
12-13	23
10-11	32
08-09	23
06-07	9
04-05	2

COMPUTE THE 85 PERCENTILE POINT OF THE DISTRIBUTION.

7. THE SCORES OF COLLEGE SENIORS ON A SCHOLASTIC APTITUDE TEST ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 52 POINTS. SUPPOSE THAT TWO SAMPLES OF 83 CASES EACH ARE RANDOMLY SELECTED - ONE FROM BOWLING GREEN STATE AND ONE FROM MIDDLEBURG COLLEGE. SUM X FOR THE FIRST SAMPLE IS 13232 AND SUM X FOR THE SECOND SAMPLE IS 14486 WHERE X(1) IS THE SCORE OF THE 1TH MEMBER OF THE SAMPLE. SETTING ALPHA AT THE .05 LEVEL. TEST THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO.

8. ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS.

MEAN X = 101

MEAN Y = 63

VARIANCE X = 27

VARIANCE Y = 26

COVARIANCE XY = 20

WHERE X(1) REPRESENTS THE SCORE OF THE 1TH INDIVIDUAL ON THE VERBAL REASONING AND Y(1) REPRESENTS THE SCORE OF THE 1TH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. COMPUTE THE ESTIMATED POPULATION STANDARD ERROR OF ESTIMATE.

Psy. 492 - Elementary Statistics

Test 1 - Spring 1968

1. GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION

15-17	3
12-14	12
09-11	20
06-08	12
03-05	3

COMPUTE THE PERCENTILE RANK CORRESPONDING TO THE SCORE OF 7.

2. GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION

16-17	2
14-15	9
12-13	23
10-11	32
08-09	23
06-07	9
04-05	2

COMPUTE THE 85 PERCENTILE POINT OF THE DISTRIBUTION.

3. GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION

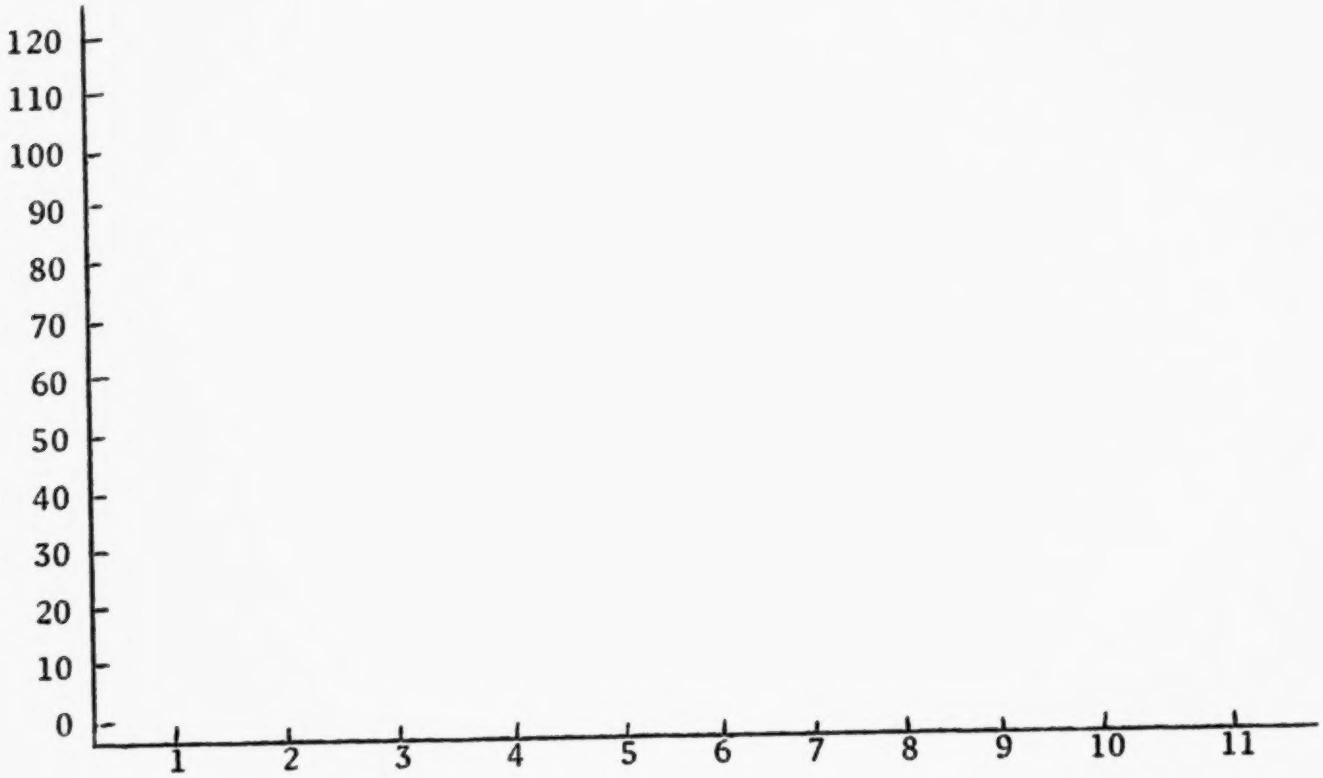
09-10	3
07-08	12
05-06	20
03-04	12
01-02	3

COMPUTE THE MEAN AND STANDARD DEVIATION OF THE ABOVE DISTRIBUTION.
NOTE: SET UP THE COMPUTING FORMULA BUT DO NOT COMPUTE OUT THE ACTUAL RESULT.

4. GRAPH THE CUMULATIVE FREQUENCY DISTRIBUTION FROM THE FOLLOWING DISTRIBUTION

09-10	5
07-08	25
05-06	40
03-04	25
01-02	5

4. CON'T.



5. ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 100

MEAN Y = 64

VARIANCE X = 94

VARIANCE Y = 29

COVARIANCE XY = 20

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE PERFORMANCE RATING OF THE ITH INDIVIDUAL. SET UP THE DEVIATION SCORE REGRESSION EQUATION FOR PREDICTING Y FROM X. JOHN HAS A DEVIATION SCORE ON X OF 3. WHAT WOULD BE HIS PREDICTED DEVIATION SCORE ON Y?

6. GIVEN THE FOLLOWING DATA

$N = 50$
$M_x = 10$
$M_y = 15$
$V_x = 49$
$V_y = 81$
$r_{xy} = 0.40$

a. WHAT IS THE PROPORTION OF VARIANCE IN Y ACCOUNTED FOR BY X?

b. WHAT IS THE STANDARD ERROR OF ESTIMATE FOR PREDICITNG X FROM Y?

c. WHAT IS $V_{\hat{y}}$ WHERE $V_y = V_{\hat{y}} + V_{y.x}$?

Psy. 492 - Elementary Statistics

Test 2 - Spring 1968

1. A TIE RACK CONTAINS 5 BLUE TIES, 13 RED TIES, 5 GREEN TIES AND 20 GREY TIES. SUPPOSE THAT ONE TIE IS SELECTED FROM THE RACK AND THE TIE IS EITHER RED OR BLUE. COMPUTE THE PROBABILITY THAT THE TIE IS RED.

2. SUPPOSE THAT 3 DICE ARE TOSSED ONE TIME. COMPUTE THE PROBABILITY THAT ONE OF THE DICE TURNS UP A 5.

3. GIVEN THE FOLLOWING ORDERED PAIRS (X,Y).

(2,4)	(3,5)	(4,6)	(5,7)	(4,6)	(6,8)
(3,2)	(4,3)	(5,4)	(6,5)	(5,6)	(7,7)
(2,3)	(3,4)	(4,5)	(5,6)	(6,7)	(7,8)
(2,4)	(3,3)	(6,2)	(5,5)	(3,6)	(8,8)

IF ONE PAIR IS RANDOMLY SELECTED FROM THIS SAMPLE SPACE AND THE SAMPLED X VALUE IS GREATER THAN 3 COMPUTE THE PROBABILITY THAT THE SAMPLED Y VALUE IS LESS THAN 6.

4. JOHN'S TRUE SCORE ON A CERTAIN TEST IS 79 AND THE STANDARD ERROR OF MEASUREMENT ON THE TEST IS 3. IF JOHN IS GIVEN ONE FORM OF THE TEST WHAT IS THE PROBABILITY THAT HIS SCORE ON THAT FORM IS AT MOST 80 POINTS?

5. SUPPOSE THAT 101 COINS ARE TOSSED. COMPUTE THE PROBABILITY THAT AT MOST 55 HEADS TURN UP.

6. THE AGCT TEST IS STANDARDIZED TO A MEAN OF 100 AND A STANDARD DEVIATION OF 20. SUPPOSE THAT 100 STUDENTS ARE RANDOMLY SELECTED FROM A CERTAIN UNIVERSITY AND THEIR AVERAGE AGCT SCORE WAS 125. IF THE TRUE MEAN FOR ALL THE STUDENTS AT THE UNIVERSITY IS 120, COMPUTE THE PROBABILITY OF OBTAINING THE SAMPLE MEAN OF 125.

7. GIVEN THE FOLLOWING HYPOTHETICAL FREQUENCY DISTRIBUTION

07-08	4
05-06	13
03-04	14
02-01	4

SUPPOSE THAT SUCCESSIVE SAMPLES OF SIZE 40 ARE RANDOMLY DRAWN (WITH REPLACEMENT) FROM THIS DISTRIBUTION. WHAT WOULD BE THE STANDARD ERROR OF THE SAMPLE MEANS.

APPENDIX D

ID _______________________
(col. 1-3)

STUDENT QUESTIONNAIRE
Department of Psychology
University of Houston

Name: ______________________________ Major: ______________________

Classification	Fr.	So.	Jr.	Sr.	PB.	Grad 1	2	3	4	Audit
(col. 6	0	1	2	3	4	5	6	7	8	9)

Sex: M F
(col.7 1 2)

Ages __________
(col. 8-9)

First Course in Statistics: Yes _____ No _____
(col. 10 1 2)

1. Please rate the difficulty of this course in terms of learning to understand statistical concepts. (check one)

(col. 11)

(5) _____ very difficult
(4) _____ moderately difficult
(3) _____ about average
(2) _____ moderately easy
(1) _____ very easy

Comment:

2. To what extent do you think that this course was effective in teaching statistical concepts. (check one)

(col. 12)

(5) _____ very effective
(4) _____ moderately effective
(3) _____ about average
(2) _____ moderately ineffective
(1) _____ very ineffective

Comment:

3. Prior to each test you were given samples of statistics problems drawn from a defined universe of content.

   a. To what extent did you use these sample problems to study for the test? (check one)

      (col. 13)

      (5) _____ used as only source
      (4) _____ used more than any other source
      (3) _____ used equally with other sources
      (2) _____ used other sources more
      (1) _____ did not use at all

      Comment:

   b. To what extent did you feel that the sample problems adequately defined what you had to learn in the course? (check one)

      (col. 14)

      (5) _____ very valuable.
      (4) _____ somewhat valuable.
      (3) _____ of no value.
      (2) _____ somewhat detrimental.
      (1) _____ very detrimental.

      Comment:

4. Some of the problems on your tests were generated by a computer from a defined universe of content.

a. Did you find the computer generated problems more difficult or easier than instructor made problems? (check one)

(col. 15)
(5) _____ very difficult
(4) _____ somewhat more difficult
(3) _____ about the same
(2) _____ somewhat easier
(1) _____ much easier

Comment:

b. Do you feel that your knowledge of statistics could be adequately tested using only test problems sampled by the computer? (check one)

(col. 16)
(5) _____ all of the time
(4) _____ most of the time
(3) _____ some of the time
(2) _____ little of the time
(1) _____ very little of the time

Comment:

c. How did the computer generated test problems compare with instructor made problems in terms of fairness? (check one)

(col. 17).
(5) _____ very fair
(4) _____ moderately fair
(3) _____ about the same
(2) _____ moderately unfair
(1) _____ very unfair

Comment:

d. Do you think that it would be desirable to draw all test problems from a defined universe of content? (check one)

(col. 18)

(5) _____ very desirable
(4) _____ somewhat desirable
(3) _____ does not matter
(2) _____ somewhat undesirable
(1) _____ very undesirable

Comment:

5. Please give any other reactions that you may have had to the computer generated test items.

APPENDIX E

PROGRAM MANUAL

Pilot Project on Computer Generated Test Items

University of Houston

DATA CARD ORGANIZATION

1. The data are arranged in the form of blocks.
2. Each data block is independent.
3. The data blocks do not have to be in any prescribed sequence.
4. Each data block has a label card and an end card. The label punched on the label card must be left-justified and correctly spelled.
5. The data block labels are as follows:

    FORMS

    RANDOM

    STRATA

    TESTS

    FORMAT

    BASES

6. The instruction labels are as follows:

    START

    FINISH

    PRINT

    PUNCH

    READ

BLOCK STRUCTURE

FORMS

Item forms are defined in a forms block. The item form is terminated by the word 'FINIS'.

Example:

```
FORMS                          Block label

0001                           Form code number (14)

XXXXXXXXXXXX                   Content

XXXXX FINIS                    End of form 0001

0024

XXXXXXXXX FINIS

0012

XXXXXX -- 2 0 XXXXX

XXXXXXXXXXX -- 14 201

XXXXX FINIS

(BLANK CARD)                   End of form block
```

RANDOM

All random expression sets are defined in a random block.

Example:

```
RANDOM                         Block label

0001                           Code number

XXXX $ XXXXXXX $ XXX

XX $ XXXXXXXXX $ FINIS

0013

XXXXX $ XXXXXX $ FINIS

etc.

(BLANK CARD)                   End card
```

It is extremely dangerous to write random expression sets which contain only one element. Generally speaking, this situation will almost always cause the program to short cycling.

The dollar sign ($) serves to delimit each random expression. A blank space must preceed and follow each dollar sign. Also, each random expression must be followed by a dollar sign.

STRATA

All forms must be assigned to a specific stratum or strata. A stratum may contain 1 or N forms.

Example:

```
STRATA                          Block label
0001                            Stratum code
1 13 2 10 19 FINIS
0009
8 FINIS

etc.

(BLANK CARD)                    End card
```

In the first stratum the item forms whose code numbers are 1, 13, 2, 10, and 19 are assembled.

BASES

DIMENSION(3) Forms, random, and strata are all stored in a 3-dimensional matrix with maximum dimensions (450, 10, 2). Storage is allocated by setting the initial location of each block in the link matrix. Forms is governed by BASE(1); RANDOM, BASE(2); and, STRATA, BASE(3).

Example:

BASE(1) = 1
BASE(2) = 10
BASE(3) = 20

Item forms would be stored from row(1) to row(9); random expressions, row(10) to row(19); and strata, row(20) to row(450).

These starting points may be defined by the user.

Example:

BASES	Block label
000100100020	(314)
(BLANK CARD)*	End block

*Not necessary, but may be included.

If no bases block is defined by the user, the program will provide the following values:

001-199	FORMS
200-399	RANDOM EXPRESSION
400-450	STRATA

TESTS

Information concerning the nature of the tests to be printed out is defined in the tests block.

Example:

TESTS	Block label
(1 card--label to be printed at top of each test)	(80A1)
(1 card--format for reading in the item codes).	(Standard Fortran format enclosed in parentheses
Number of items per test, number of tests	2I4
XXXXXXX	Item codes
XXXXX	
(BLANK CARD)*	End of block

* Not necessary, but may be included.

START

Begin generating tests.

FINISH

Stop the program.

PRINT

All material stored in the link matrix, text vector, and the FT matrix (special format codes) is printed out. However, with link the user must specify a starting and stopping row subscript in link.

Example:

PRINT	Block label
0010500	2I4
(BLANK CARD)*	End of block

* Not necessary, but may be included.

PUNCH

Similar to PRINT, only cards are punched out.

READ

Material punched out from a previous program is to be read in.

Example:

READ	Block label
(Block of punched cards in same order as punched out by the program.)	
(BLANK CARD)	End of block

FORMAT

Special formats (see Format section) are stored via the format block.

Example:

FORMAT	Block label
0001 XXXXXXX (Format code number followed by format)	(I4,12A6)
(BLANK CARD)	End of block

ITEM FORMS (STRUCTURE)

Item forms may be constructed as follows:

1. Containing no random expressions.
2. Containing only random expressions.
3. Containing both random expressions and standard text. Random expressions may be inserted at any place in the item form.

Each random expression set is assigned a number by the user. The random expressions set is linked to the form by placing the random expression set code number at the appropriate place in the form and preceeding this number by a double (--) minus sign. Immediately following this negatively signed random expressions set code number must be another number--the dependency link with another random expression set.

Example:

XXXXXXX --2 1 XXXXXX

Meaning: A random expression from set 2 is desired. However, the selection is dependent upon the alternative chosen previously from 1. If, for example, the third alternative had been selected from 1 choose the third alternative from 2 also. If no dependency is desired, place a zero following the negative number.

The form (when punched as data) must be ended or terminated by the specific word 'FINIS' which must be preceeded by a blank space.

The item form must also contain the necessary format information to be used at print-out time. See 'Format' section.

An item form may contain a random expression which within itself contains a random expression. The degree of nesting is limited to 1.

A nested random expression may not contain a call to RNUMBR for a random number.

FORMAT FOR PRINTING OUT ITEM FORMS:

The user may specify the item form format by inserting the standard Fortran format codes within the item form. The format codes must be delimited by slashes, i.e., /01X/,/1HO/, and /10X/. Including the slashes, the format word must occupy five columns. The format codes may be placed in sequence, i.e., /1HO//10X/. If the format is in this form, do not leave a space between the two codes.

If the format for a specified number of lines is being repeated, the user may avoid writing the same format NN times by using the /RNN/ XXXXXX /FXX/ format option, where

/RNN/ indicated that the format before the next format code is being repeated NN times.

/FXX/ is a special format coded 'XX' describing the individual line being replicated. This format must be specified in a format data block.

Examples:

Given a normal distribution with mean $0102 10 0 20 0 1 and variance $0102 5 0 8 0 /1HO/. If one number is selected at random from this distribution /1HO/ what is the probability that the number will be greater than $0102 0 +1-2-2 0 +1+2+2 0?

Given the following frequency distribution /1HO//R09/ $002 100139 /F02//1HO/ compute the mean.

Note: If the output format exceeds 80 columns, the program will automatically insert a /1HO/.

RNUMBR SUBROUTINE

Purpose: The RNUMBR subroutine is specifically designed to supply all random numbers and distributions of numbers to be used by the item forms.

RNUMBR requires 5 or 6 words

1. $1234
2. Integer number lower limit of range for desired random number
3. Operations code word for lower limit
4. Integer number upper limit of range for desired random number
5. Operations code word for upper limit
6. Switch describing what is to be done with generated random number or numbers.

Word-1:

$1234

$ Break character calling RNUMBR subroutine

1-2 Number of similar random numbers desired (01 99)

3 Code for distributions (1 4)

4 Number of digits desired behind decimal point

		MAX
FOR	Integers	5
	Fractions	4

Distribution Codes

1. Single probability distribution
2. Single frequency distribution
3. Joint probability distribution.
4. Joint frequency distribution

Word-2:

Integer number specifying the lower bound for random number.

Word-3:

Operations code word for lower limit. The OP code word is used to link a presently desired random number with previously-generated random numbers in a specific form.

Example:

```
XXXX $01 10 0 20 0 1 XXXX $01 5 0 9 0 1XXXX $01 0 +1-2-2 0 +1+2+2 0 XXXX
```

The first random number generated lies between 10 and 20 and is stored in the first 'SAVE' position (the '1' on the end does not refer to the first SAVE position); the second, between 5 and 8 and stored in the second 'SAVE' position. However, the third random number is dependent upon the first two random numbers. This dependency is accomplished in the following manner via an OP code word.

```
Example of OP code word (0      +1-2-2      0      +1+2+2)
                         L(1)               L(2)
```

'SAVE'	OP code word
1. $10 \le R_1 \le 20$	+1-2-2 6 characters
2. $5 \le R_2 \le 8$	
3.	
4.	

At maximum, the OP code word can hold 3 OPs and 3 subscripts. If fewer characters are needed, leave remaining spaces blank. The random numbers are stored in the order in which they are generated within the form.

Meaning:

Add SAVE (1) to L(1)

Sub SAVE (2) from sum

Sub SAVE (2) from sum

+1+2+2

Meaning:

Add SAVE (1) to L(2)

Add SAVE (2) to sum

Add SAVE (3) to sum

In this example, a random number has been generated with the following properties

$$\text{MEAN} - 2\text{SD} \le \text{RANDOM} \le \text{MEAN} + 2\text{SD}$$

Word-4:

Integer number specifying the upper bound for random number.

Word-5:

OP code for upper limit.

Word-6:

A 'SWITCH' value which is used to set up a dependency among a set of random numbers within a form. A dependency is formed by storing previously generated random numbers. The first random number stored is placed in the first 'SAVE' position, etc. The maximum number of 'SAVED' values within a specific form is 9.

The SWITCH Codes for word-6 are as follows:

0 Print out, do not store, set counter to zero (SAVE also set to 0)

1 Print out, store, increment counter.

2 Do not print out, store, increment counter

3 Print out, do not store, do not change counter.

Note: If no word-6 SWITCH is used, a zero is asscumed.

FREQUENCY DISTRIBUTIONS

$0012

1 Code for distribution

2 If probability distribution is desired, the number of digits to the right of the decimal point must be specified.

Example:

$0012	Probability dist., two digits
$002	Frequency dist., integer values.

When a distribution is desired, the first word following the '$XXXX' must contain the information describing the distribution.

XXXXXX	1-3	The total N for a frequency distribution. If a probability distribution is desired, use 000
	4	The starting value of the lowest interval
	5	The width of each interval
	6	Number of intervals

Note: Must have /1HO/ before each distribution.

Example:

044116

	Freq.	Prob.
11-12	1	.02
9-10	7	.14
7-8	14	.34
5-6	14	.34
3-4	7	.14
1-2	1	.02

The maximum interval number is 99.

Maximum number of intervals is 9.

In writing format statements for frequency distributions note that numbers are stored in blocks of 5 on the output buffer. Example:

0	9	-	1	0
			2	1
.	3	7		

JOINT DISTRIBUTIONS

The first word following $XXXX contains the information describing both distributions.

XXXXXX
123456

1 Starting point for vertical distribution

2 Width for vertical distribution

3 Number of intervals for vertical distribution

4 Starting point for horizontal distribution

5 Width for horizontal distribution

6 Number of intervals for horizontal distribution

The maximum number of intervals is 9. When a frequency distribution is desired, a number between 200 and 300 is randomly generated for the total N. This number will be a multiple of 10.

Example:

315124

11-12	X	X	X	X
09-10	X	X	X	X
07-08	X	X	X	X
05-06	X	X	X	X
03-04	X	X	X	X
	01-03	04-06	07-09	10-12

DIAGNOSTICS PROVIDED BY PROGRAM

MAIN

1. Storage allocations should have been specified before calling MAKTXT. The following values have been inserted by the program

001-199	FORMS
200-399	RANDOM EXPRESSIONS
400-450	STRATA

Interpretation: No bases block was inserted in data deck.

2. Unable to locate XXXXXX in label dictionary. Program regretfully terminated.

Interpretation: A data block label was not in the prescribed form.

Possible sources of error:

1. Misspelled block label.
2. Label not left-justified.

MAKTXT

Column subscript out of range for link matrix N-1 N-2 N-3.

N-1	Column subscript
N-2	Base
N-3	Code number of FORM, RANDOM EXPRESSION, or STRATUM.

The respective row in link will also be printed out.

Interpretation: The link matrix has dimensions (450, 10 2). The column count on link has exceeded 10. This is a serious error and can result from a multitude of data deck preparation erros.

TESTS

1. Form code number is out of range (FORM CODE NUMBER).

Interpretation: FORM CODE NUMBER is greater than or equal to BASE(2) or less than BASE(1). Check the three bases and the form code in question.

2. Item code number is out of range (ITEM CODE NUMBER).

Interpretation: ITEM CODE NUMBER is equal to zero or greater than (500 - BASE(3))*10

3. Random expression set pointer 1 is out of range (RANDOM EXPRESSION POINTER VALUE).

Interpretation: Code number of RANDOM EXPRESSION set selected is either less than BASE(2) or greater than or equal to BASE(3).

4. Random expression set pointer 2 is out of range (RANDOM EXPRESSION POINTER VALUE).

Interpretation: Similar to No. 3.

RNUMBR

Number of digits requested in probability is zero. Program will continue with three digits.

Interpreation: No digits to the right of the decimal point is considered an abnormal situation.

APPENDIX F

```
10471047  45.00 005000 000000 X                OSBURN-SHOEMAKER
ON AT  5.814(HRS) 08/16/68
N F:5,(DEVICE,SI)
N F:6,(DEVICE,LO)
GN F:1,(DEVICE, MTA81)
GN F:2,(DEVICE, MTA82)
N F:3,(DEVICE, MTA83)
AN
C     ******************************************************************
C
C      OSBURN-SHOEMAKER COMPUTER-AIDED ITEM SAMPLING FOR ACHIEVEMENT
C      TESTING
C
C      H.G. OSBURN PSYCHOLOGY DEPARTMENT UNIVERSITY OF HOUSTON
C      DAVID M. SHOEMAKER PSYCHOLOGY DEPT OKLAHOMA STATE UNIVERSITY
C
C      MAIN MONITOR SUBPROGRAM -- READS DATA BLOCK LABELS AND CALLS
C                                 APPROPRIATE SUBPROGRAMS
C
C     ******************************************************************
      REAL*8 TEXT
      REAL*8 KODE
      REAL*8 LABEL
      INTEGER BASE,START,STOP,REELS,TSAVE
      COMMON /BLOCK1/ TEXT(9000),NT,LINK(450,10,2)
      COMMON /BLOCK2/ BUFFER(1000),NB,NIX
      COMMON /BLOCK3/ BASE(3),B(120),FT(20,15)
      COMMON /BLOCK4/ REELS(4),NREELS,LTAPE(450),TSAVE,NSAVE,ITAPE(4)
      DIMENSION KODE(12),TITLE(18),FMT(18),ITEM(200),TEMP(2,15)
      DATA KODE/'FORMS','RANDOM','STRATA','TESTS','START','FINISH',
     1'PUNCH','READ','PRINT','FORMAT',' ','BASES'/
      BASE(1)=0
      NT=0
      DO 25 I=1,20
 25   FT(I,1)=0.
      DO 40 I=1,450
      DO 40 J=1,2
      DO 40 K=1,10
 40   LINK(I,K,J)=0
      DO 41 I=1,4
 41   ITAPE(I)=0
 20   READ (5,72) LABEL
      DO 35 I=1,12
      IF(LABEL.EQ.KODE(I))GO TO
     1     (100,100,100,400,500,600,700,800,900,1000,20,1100),I
 35   CONTINUE
      WRITE (6,15) LABEL
      STOP
 100  IF ( BASE(1) .NE. 0 ) GO TO 110
      BASE(1)=1
      BASE(2)=200
      BASE(3)=400
      WRITE (6,14)
 110  CALL MAKTXT(BASE(I))
      GO TO 20
 400  READ (5,1) (TITLE(I),I=1,18),(FMT(I),I=1,18),NITEMS,NTESTS
      READ (5,FMT) (ITEM(I),I=1,NITEMS)
      GO TO 20
 500  IF ( BASE(1) .NE. 0 ) GO TO 510
      BASE(1)=1
      BASE(2)=200
      BASE(3)=400
      WRITE (6,14)
510   ASSIGN 515 TO KK
      GO TO 5000
515   NNN=NT
      NNN=IABS(NNN)
      XX1=FLOAT(NNN)/2.
      XX2=NNN/2
      IF ( XX1 .EQ. XX2 ) NNN=NNN+1
      NIX=NNN
      CALL TESTS(ITEM,NITEMS,NTESTS,TITLE)
      GO TO 20
600   WRITE (6,2)
      STOP
700   ASSIGN 710 TO KK
      GO TO 5000
710   READ (5,3) START,STOP
      DO 750 I=START,STOP
      IF ( LINK(I,1,1) .EQ. 0 ) GO TO 750
      WRITE (6,54) I, ((LINK(I,J,K),J=1,10),K=1,2)
750   CONTINUE
      WRITE (6,69)
      DO 770 I=1,4
      IF ( ITAPE(I) .EQ. 0 ) GO TO 770
      NTAPE=REELS(I)
      REWIND NTAPE
      READ (NTAPE)   NT,(TEXT(J),J=1,NT)
      WRITE (6,66) NTAPE
      WRITE (6,56) NT, (TEXT(J),J=1,NT)
770   CONTINUE
      WRITE (6,67)
      WRITE (6,71) (LTAPE(I),I=1,450)
      GO TO 20
800   DO 820 II=1,450
      READ (5,3) I
      IF ( I .EQ. (-0) ) GO TO 850
      READ (5,22)  ((TEMP(J,K),K=1,10),J=1,2)
      DO 820 J=1,2
      DO 820 K=1,10
820   LINK(I,K,J)=TEMP(J,K)
850   DO 860 I=1,10
      READ (5,18) NTAPE
      IF ( NTAPE .EQ. (-0) ) GO TO 870
      READ (5,5) NT,(TEXT(J),J=1,NT)
      REWIND NTAPE
      WRITE (NTAPE)   NT,(TEXT(J),J=1,NT)
      END FILE NTAPE
      DO 860 J=1,4
      IF ( REELS(J) .EQ. NTAPE ) ITAPE(J)=-1
860   CONTINUE
870   READ (5,21) (LTAPE(I),I=1,450)
      GO TO 20
900   ASSIGN 910 TO KK
      GO TO 5000
910   READ (5,3) START,STOP
      WRITE (6,10) START,STOP
      DO 920 I=START,STOP
      IF ( LINK(I,1,1) .EQ. 0 ) GO TO 920
      WRITE (6,7) I,LTAPE(I),((LINK(I,K,J),K=1,10),J=1,2)
920   CONTINUE
      WRITE (6,3 ) (ITAPE(K),K=1,4)
      DO 950 I=1,4
      IF ( ITAPE(I) .EQ. 0 ) GO TO 950
      NTAPE=REELS(I)
      REWIND NTAPE
      READ (NTAPE) NT,(TEXT(J),J=1,NT)
      WRITE (6,8) NTAPE,NT,(TEXT(J),J=1,NT)
950   CONTINUE
      WRITE (6,11)
      K=0
      DO 930 I=1,20
      IF ( FT(I,1) .EQ. 0 ) GO TO 930
      K=1
      WRITE (6,12) I,(FT(I,J),J=1,15)
930   CONTINUE
      IF ( K .EQ. 0 ) WRITE (6,13)
      GO TO 20
1000  DO 1050 I=1,20
      READ (5,9) NR,(TEMP(1,J),J=1,15)
      IF ( NR .EQ. (-0) ) GO TO 20
      DO 1050 J=1,15
1050  FT(NR,J)=TEMP(1,J)
1100  READ(5,3) (BASE(I),I=1,3)
      GO TO 20
5000  IF ( ITAPE(NREELS) .EQ.(-1)) GO TO 5001
      LAST=REELS(NREELS)
      REWIND LAST
      WRITE (LAST) NT,(TEXT(K),K=1,NT)
      END FILE LAST
      ITAPE(NREELS)=-1
5001  GO TO KK,(515,710,910)
1      FORMAT (18A4/18A4/2I4)
2      FORMAT (34H1PROGRAM TERMINATED BY FINISH CARD)
3      FORMAT (10I4)
4      FORMAT (I4/20I4)
5      FORMAT (I5/(1X,19A4))
6      FORMAT (I5/(1X,19A4))
7      FORMAT (I5,2H (,I2,1H),2(5X,10I5))
8      FORMAT (12H1TAPE NUMBER,I5///I5//(1X,15A8))
9      FORMAT (I4,15A4)
10     FORMAT (27H1PRINT-OUT OF LINK FROM ROW,I5,7H TO ROW,I5//)
11     FORMAT (31H1FORMAT CODES SPECIFIED BY USER//10X,4HCODE,10X,
      16HFORMAT//)
12     FORMAT (10X,2H/F,I3,1H/,8X,15A4)
13     FORMAT (27H0NO FORMAT CODES IN STORAGE)
14     FORMAT (69H1LINK STORAGE ALLOCATIONS UNSPECIFIED AT CRITICAL TIM
      1 THEREFORE ...//55H0THE FOLLOWING VALUES HAVE BEEN INSERTED BY T
      2 PROGRAM//14H0001-199 FORMS//27H0200-399 RANDOM EXPRESSIONS//15H
      300-450 STRATA)
15     FORMAT (19H1UNABLE TO LOCATE ',A8,21H' IN LABEL DICTIONARY//31H
      1OGRAM REGRETFULLY TERMINATED)
16     FORMAT (4HTAPE,I4)
17     FORMAT (8X,19HEND OF TAPE STORAGE)
18     FORMAT (4X,I4)
19     FORMAT (6X,18HEND OF LINK MATRIX)
21     FORMAT (80I1)
22     FORMAT (20I4)
54     FORMAT (1H$,I4/1H$,20I4)
69     FORMAT (1H$,6X,18HEND OF LINK MATRIX)
56     FORMAT (1H$,I5/2H$ , 9A8)
66     FORMAT (5H$TAPE,I4)
67     FORMAT (1H$,8X,19HEND OF TAPE STORAGE)
71     FORMAT (1H$,80I1)
72     FORMAT (A8)
```

```
        END

SUBPROGRAMS

 BF:PIN      BF:S3       BF:DI       BF:SF       BF:SG       BF:S6       BF:SX
 BF:FI       BF:II       BF:SA       IABS        FLOAT       BF:ITF      TESTS
 BF:S2       BF:FTI      BF:S5       BF:SE       BF:SJ

PROGRAM ALLOCATION

4DE.0       I           4DF.0       J           4E0.0       K           4E2.0       LABEL
4E5.0       NTESTS      4E6.0       KK          4E7.0       NNN         4E8.0       XX1
4EA.0       START       4EB.0       STOP        4EC.0       NTAPE       4ED.0       II
4EF.0       LAST

4F0.0       KODE        508.0       TITLE       51A.0       FMT         52C.0       ITEM

/BLOCK1  / ALLOCATION 6979    WORDS

0.0         TEXT        4650.0      NT          4651.0      LINK


/BLOCK2  / ALLOCATION 3EA     WORDS

0.0         BUFFER      3E8.0       NB          3E9.0       NIX


/BLOCK3  / ALLOCATION 1A7     WORDS

0.0         BASE        3.0         B           78.0        FT


/BLOCK4  / ALLOCATION 1CD     WORDS

0.0         REELS       4.0         NREELS      5.0         LTAPE       1C7.0       TSAVE
1C9.0       ITAPE



PROGRAM END


C     ************************************************************
C
C      MAKTXT (MAKE TEXT) SUBPROGRAM -- READS ALPHANUMERIC DATA FROM
C      CARDS AND STORES IN CORE OR ON TAPE.  MAKTXT CONSTRUCTS AN
C      ACCOUNTING SYSTEM -- THE LINK MATRIX -- FOR DATA RETRIEVAL.
C
C     ************************************************************
      SUBROUTINE MAKTXT(LBASE)
      INTEGER C,ROW,START,BASE,TSAVE,REELS
      REAL*8 TEXT
      REAL*8 END
      REAL*8 TWORD
      REAL*8 LNK
      REAL MINUS
      COMMON /BLOCK1/ TEXT(9000),NT,LINK(450,10,2)
      COMMON /BLOCK3/ BASE(3),B(120),FT(20,15)
      COMMON /BLOCK4/ REELS(4),NREELS,LTAPE(450),TSAVE,NSAVE,ITAPE(4)
      DIMENSION CARD(81),WORD(8)
      DATA BLANK,MINUS,DSGN,END,LNK/' ','-','$','FINIS','LNK'/
      CARD(81)=BLANK
      C=0
      DO 11 I=1,4
      IF ( ITAPE(I) .LT. 0 ) GO TO 11
      NREELS=I
      GO TO 50
 11   CONTINUE
      WRITE (6,6)
      STOP
 50   READ(5,1) ROW
      IF ( ROW .EQ. (-0) ) GO TO 400
      IROW=ROW
 15   NTAPE=REELS(NREELS)
      IF ( NT .LE. 8700 ) GO TO 10
      REWIND NTAPE
      WRITE (NTAPE) NT,(TEXT(K),K=1,NT)
      END FILE NTAPE
      ITAPE(NREELS)=-1
      DO 16 I=1,4
      IF ( ITAPE(I) .LT. 0 ) GO TO 16
      NREELS=I
      NT=0
      GO TO 15
 16   CONTINUE
      WRITE (6,6)
      STOP
 10   IF ( LBASE .NE. BASE(3) ) GO TO 17
      X=FLOAT(ROW)/10.
      ROW=X
      C=10.*(X-FLOAT(ROW))+.5
      IF ( C .NE. 0 ) GO TO 18
      C=10
      ROW=ROW-1
 18   ROW=ROW+LBASE
      GO TO 19
 17   ROW=ROW+LBASE-1
 19   LTAPE(ROW)=NTAPE
      IF ( LBASE .EQ. BASE(2) ) LINK(ROW,10,1)=0
      IF ( ROW .LT. BASE(3) ) C=0
      START=NT+1
 100  READ (5,2) (CARD(I),I=1,80)
      I=1
 105  IF ( I .GT. 80 ) GO TO 100
      IF ( CARD(I) .NE. BLANK ) GO TO 110
      I=I+1
      GO TO 105
 110  DO 120 J=2,8
 120  WORD(J)=BLANK
      DO 130 J=1,8
      IF ( CARD(I) .EQ. BLANK ) GO TO 140
      WORD(J)=CARD(I)
 130  I=I+1
 140  IF(WORD(1).EQ.MINUS.AND.WORD(2).EQ.MINUS.AND.LBASE.EQ.BASE(1))
```

```
     1GO TO 180
      NT=NT+1
      IF ( WORD(1) .NE. DSGN  ) GO TO 150
      IF ( WORD(2) .NE. BLANK ) GO TO 150
      IF ( LBASE .EQ. BASE(1) ) GO TO 150
      C=C+1
      NT=NT-1
      IF ( C .GT. 9 ) GO TO 9995
      LINK(ROW,C,1)=START
      LINK(ROW,C,2)=NT
      LINK(ROW,10,1)=LINK(ROW,10,1)+1
      GO TO 220
150   CALL COMPZ(8,WORD,TEXT(NT))
      IF ( TEXT(NT) .NE. END ) GO TO 155
      NT=NT-1
      IF ( LBASE .EQ. BASE(2) ) GO TO 50
      IF ( LBASE .EQ. BASE(1) .AND. NT .LE. START ) GO TO 50
      IF ( ROW .LT. BASE(3) ) GO TO 170
      GO TO 175
155   IF ( CARD(I) .EQ. BLANK ) GO TO 105
      NT=NT+1
      TEXT(NT)=LNK
      GO TO 105
170   C=C+1
      IF ( C .GT. 10 ) GO TO 9999
175   LINK(ROW,C,1)=START
      LINK(ROW,C,2)=NT
      GO TO 50
180   IF ( NT .LE. START ) GO TO 185
      C=C+1
      IF ( C .GT. 10 ) GO TO 9999
      LINK(ROW,C,1)=START
      LINK(ROW,C,2)=NT
185   C=C+1
      WORD(1)=BLANK
      WORD(2)=BLANK
      CALL COMPZ(8,WORD,TWORD)
      CALL CTOF(TWORD,F,IF)
      IF ( C .GT. 10 ) GO TO 9999
      LINK(ROW,C,1)=-IF
      DO 190 J=2,8
190   WORD(J)=BLANK
      I=I+1
      DO 200 J=1,8
      IF ( CARD(I) .EQ. BLANK ) GO TO 210
      WORD(J)=CARD(I)
200   I=I+1
210   CALL COMPZ(8,WORD,TWORD)
      CALL CTOF(TWORD,F,LINK(ROW,C,2))
220   START=NT+1
      I=I+1
      GO TO 105
9999  WRITE (6,3) C,LBASE,IROW
      WRITE (6,4) ROW,((LINK(ROW,K,J),K=1,10),J=1,2)
      STOP
400   RETURN
1     FORMAT (I4)
2     FORMAT (80A1)
3     FORMAT (49H1COLUMN SUBSCRIPT IS OUT OF RANGE FOR LINK MATRIX,3I
4     FORMAT (//I6,2(5X,10I5),//31H0PROGRAM REGRETFULLY TERMINATED)
6     FORMAT (39H4PROGRAM HAS EXCEEDED AVAILABLE STORAGE)
      END
```

```
SUBPROGRAMS

  BF:S6       BF:SF       BF:SX       BF:S3       BF:II       BF:ST       BF:S5
  BF:SE       FLOAT       BF:FTI      BF:FI       COMPZ       CTOF        BF:SS


PROGRAM ALLOCATION

2EE.0      MAKTXT     2EF.0      BLANK      2F0.0      MINUS      2F1.0      DSGN
2F4.0      LNK        2F6.0      C          2F7.0      I          2F8.0      ROW
2FA.0      NTAPE      2FB.0      K          0.0        LBASE      2FC.0      X
2FE.0      J          300.0      TWORD      302.0      F          303.0      IF

304.0      CARD       355.0      WORD

/BLOCK1  / ALLOCATION 6979     WORDS

0.0        TEXT       4650.0     NT         4651.0     LINK


/BLOCK3  / ALLOCATION 1A7      WORDS

0.0        BASE       3.0        B          7B.0       FT


/BLOCK4  / ALLOCATION 1CD      WORDS

0.0        REELS      4.0        NREELS     5.0        LTAPE      1C7.0      TSAVE
1C9.0      ITAPE



PROGRAM END
```

```
C     ************************************************************
C
C      PRINTO SUBPROGRAM -- PARSES OUT FORMAT CODES FROM ITEM FORM
C      AND CONSTRUCTS A STANDARD FORTRAN FORMAT VECTOR FOR PRINTING
C      ITEM.
C
C     ************************************************************
      SUBROUTINE PRINTO(II)
      REAL IDROP,LBRK,ISAVE
      INTEGER FMTN,START,FSTOP,SWITCH,BASE
      COMMON /BLOCK2/ BUFFER(1000),NB,NIX
      COMMON /BLOCK3/ BASE(3),B(120),FT(20,15)
      DIMENSION FMT(200),BCD(10)
      DATA BCD/'0','1','2','3','4','5','6','7','8','9'/
      DATA COMMA,SLASH,BLANK,AFLD/',','/',' ','A1,'/
      DATA LBRK,RBRK/'(1X,',')'/
      DATA F,H,X,R/'F','H','X','R'/
      DATA IDROP/'/1X,'/
      BUFFER(NB)=BLANK
      START=1
      FMTN=1
      NCHAR=0
      NLINE=0
      TEMP=BLANK
      DO 50 I=1,200
 50   FMT(I)=TEMP
      FMT(1)=LBRK
      SWITCH=0
 150  DO 100 I=START,NB
      IF ( BUFFER(I  ) .NE. SLASH ) GO TO 200
      IF ( BUFFER(I+4) .NE. SLASH ) GO TO 200
      FMTN=FMTN+1
      IF ( BUFFER(I+1) .EQ. R      ) GO TO 600
      IF ( SWITCH      .EQ. 1      ) GO TO 500
      IF ( NCHAR       .EQ. 0      ) GO TO 160
      FMT(FMTN)=B(NCHAR)
      FMT(FMTN+1)=AFLD
      FMTN=FMTN+2
 160  IF ( BUFFER(I+2) .EQ. H      ) GO TO 300
      IF ( BUFFER(I+3) .EQ. X      ) GO TO 400
      IF ( BUFFER(I+1) .EQ. F      ) GO TO 500
 300  BUFFER(I+4)=COMMA
      DO 305 J=1,4
      K=J-1
      CALL PKONE (BUFFER(I),0,FMT(FMTN),K)
 305  I=I+1
 310  START=I+1
      IF ( BUFFER(START) .EQ. BLANK ) START=START +1
      NCHAR=0
      GO TO 150
 400  BUFFER(I)=BLANK
      GO TO 300
 500  DO 510 K=1,10
      IF ( BUFFER(I+2) .EQ. BCD(K) ) K1=K-1
      IF ( BUFFER(I+3) .EQ. BCD(K) ) K2=K-1
 510  CONTINUE
      KK=K1*10+K2
      FSTOP=FMTN+14
      JJ=0
      DO 520 K=FMTN,FSTOP
      JJ=JJ+1
 520  FMT(K)=FT(KK,JJ)
      FMTN=FSTOP+1
      SWITCH=0
      I=I+4
      GO TO 310
 600  DO 610 K=1,10
      IF ( BUFFER(I+2) .EQ. BCD(K) ) K1=K-1
      IF ( BUFFER(I+3) .EQ. BCD(K) ) K2=K-1
 610  CONTINUE
      KK=K1*10+K2
      FMT(FMTN)=B(KK)
      START=I+6
      SWITCH=1
      GO TO 150
 200  IF ( SWITCH .EQ. 1 ) GO TO 230
      IF ( NCHAR .LE. 65 ) GO TO 230
      I15=I+15
      DO 210 KK=I,I15
      IF ( BUFFER(KK) .EQ. BLANK ) GO TO 220
      NLINE=NLINE+1
      BUFFER(NLINE)=BUFFER(KK)
210   NCHAR=NCHAR+1
      KK=I15
220   FMTN=FMTN+1
      FMT(FMTN)=B(NCHAR)
      FMT(FMTN+1)=AFLD
      FMT(FMTN+2)=IDROP
      FMTN=FMTN+3
      NCHAR=0
      START=KK+1
      GO TO 150
230   NLINE=NLINE+1
      BUFFER(NLINE)=BUFFER(I)
100   NCHAR=NCHAR+1
      FMTN=FMTN+1
      FMT(FMTN)=  B(NCHAR)
      FMT(FMTN+1)=AFLD
      FMT(FMTN+2)=RBRK
      FMTN=FMTN+2
      WRITE (6,6) II
      WRITE (6,FMT) (BUFFER(I),I=1,NLINE)
      DO 1000 I=100,1000
1000  BUFFER(I)=BLANK
      RETURN
6     FORMAT (//5H NO. ,I3//)
      END


SUBPROGRAMS

 PKONE      BF:S6      BF:II      BF:SF      BF:FI      BF:SS      BF:SR

PROGRAM ALLOCATION

218.0     PRINTO   219.0    COMMA    21A.0    SLASH    21B.0    BLANK
21D.0     LBRK     21E.0    RBRK     21F.0    F        220.0    H
222.0     R        223.0    IDROP    224.0    START    225.0    FMTN
227.0     NLINE    228.0    TEMP     229.0    I        22A.0    SWITCH
22C.0     K        22D.0    K1       22E.0    K2       22F.0    KK
231.0     JJ       232.0    I15      0.0      II

233.0     FMT      2F8.0    BCD

/BLOCK2  / ALLOCATION 3EA    WORDS

0.0       BUFFER   3E8.0    NB       3E9.0    NIX


/BLOCK3  / ALLOCATION 1A7    WORDS

0.0       BASE     3.0      B        78.0     FT



PROGRAM END
```

```
C       ****************************************************************
C
C        TESTS SUBPROGRAM -- GIVEN AN ITEM FORM, TESTS SUPPLIES ELEMENTS
C        FROM REPLACEMENT SETS AND CONSTRUCTS AN INDIVIDUAL ITEM.
C
C       ****************************************************************
        SUBROUTINE TESTS(ITEM,NITEMS,NTESTS,TITLE)
        REAL*8 TEMP
        REAL*8 TEXT
        REAL*8 TWORD
        REAL*8 TX
        REAL*8 LNK
        REAL MINUS,NWORD
        INTEGER ROW,BASE,SUB,FORM,SAVE,REELS,TSAVE,T
        COMMON /BLOCK1/ TEXT(9000),NT,LINK(450,10,2)
        COMMON /BLOCK2/ BUFFER(1000),NB,NIX
        COMMON /BLOCK3/ BASE(3),B(120),FT(20,15)
        COMMON /BLOCK4/ REELS(4),NREELS,LTAPE(450),TSAVE,NSAVE,ITAPE(4)
        DIMENSION DCWORD(8),NWORD(8),ITEM(100),TITLE(18)
        DATA LNK,DSGN,BLANK,MINUS/'LNK','$',' ','-'/
        SAVE=0
        NSTR=(450-BASE(3))*10
        DO 1000 T=1,NTESTS
        WRITE (6,1) (TITLE(I),I=1,18)
        DO 1000 K=1,NITEMS
        IF ( ITEM(K).NE.0.AND.ITEM(K).LE.NSTR ) GO TO 20
        WRITE (6,3) ITEM(K)
        GO TO 1000
   20   X=FLOAT(ITEM(K))/10.
        ROW=X
        IY=10.*(X-FLOAT(ROW))+.5
        IF ( IY .NE. 0 ) GO TO 15
        IY=10
        ROW=ROW-1
   15   IX=BASE(3)+ROW
        S1=LINK(IX,IY,1)
        S2=LINK(IX,IY,2)
   30   CONTINUE
        CALL RANDU(NIX,NIY,X)
        NIX=NIY
        NN=S1+X*(S2-S1)+.5
        IF ( NN .LT. IFIX(S1) ) NN=S1
        IF ( NN .GT. IFIX(S2) ) NN=S2
        CALL TCHECK(IX)
        CALL CTOF(TEXT(NN),X,FORM)
        IF ( FORM .LT. BASE(1) .OR. FORM .GE. BASE(2) ) GO TO 9999
        NB=0
        DO 500 N=1,10
        IF ( LINK(FORM,N,1) .EQ. 0 ) GO TO 600
        L1=LINK(FORM,N,1)
        L2=LINK(FORM,N,2)
        IF ( L1 .LT. 0 ) GO TO 200
        CALL TCHECK(FORM)
   40   DO 50 I=L1,L2
        IF ( TEXT(I) .NE. LNK ) GO TO 60
        NB=NB+1
        GO TO 50
   60   CALL DCOMPZ(1,TEXT(I),DCWORD)
        IF ( DCWORD(1) .NE. DSGN  ) GO TO 69
        DO 65 II=3,8
```

```
65    NWORD(II)=BLANK
      NWORD(1)=DCWORD(2)
      NWORD(2)=DCWORD(3)
      CALL COMPZ(8,NWORD,TWORD)
      CALL CTOF(TWORD,F,NREPS)
      L1=I+1
      TEMP=DCWORD(5)
      CALL B47(TEMP)
      CALL CTOF(TEMP,F,NPLACE)
      TEMP=DCWORD(4)
      CALL B47(TEMP)
      CALL CTOF(TEMP,F,IDSTRB)
      CALL RNUMBR(L1,SAVE,NREPS,IDSTRB,NPLACE)
      IF ( L1 .GT. L2 ) GO TO 500
      GO TO 40
69    IF ( DCWORD(1) .NE. MINUS ) GO TO 70
      IF ( DCWORD(2) .NE. MINUS ) GO TO 70
      DCWORD(1)=BLANK
      DCWORD(2)=BLANK
      CALL COMPZ(8,DCWORD,TX)
      CALL CTOF(TX,F,L11)
      CALL CTOF(TEXT(I+1),F,L22)
      L1=I+2
      JTAPE =NSAVE
      IF ( L22 .EQ. 0 ) GO TO 61
      L22=L22+BASE(2)-1
      NC=LINK(L22,10,2)
      LL=L11+BASE(2)-1
      L11=LINK(LL,NC,1)
      L22=LINK(LL,NC,2)
      CALL TCHECK(LL)
      GO TO 63
61    L11=L11+BASE(2)-1
62    CONTINUE
      CALL RANDU(NIX,NIY,X)
      NIX=NIY
      SUB=X*FLOAT(LINK(L11,10,1))+.5
      IF ( SUB .EQ. LINK(L11,10,2) ) GO TO 62
      IMAX=LINK(L11,10,1)
      IF ( SUB .GT. IMAX) SUB=IMAX
      IF ( SUB .LT. 1 ) SUB=1
      LL=L11
      CALL TCHECK(LL)
      L11=LINK(LL,SUB,1)
      L22=LINK(LL,SUB,2)
      LINK(LL,10,2)=SUB
63    DO 66 J=L11,L22
      IF ( TEXT(J) .NE. LNK ) GO TO 64
      NB=NB-1
      GO TO 66
64    CALL DCOMPZ(1,TEXT(J),DCWORD)
      DO 67 KK=1,8
      IF ( DCWORD(KK),EQ.BLANK) GO TO 68
      NB=NB+1
67    BUFFER(NB)=DCWORD(KK)
68    NB=NB+1
      BUFFER(NB)=BLANK
66    CONTINUE
      IF ( L1 .GT. L2 ) GO TO 500
      CALL TCHECK(JTAPE)
      GO TO 40
70    DO 75 KK=1,8
```

```
      IF ( DCWORD(KK) .EQ. BLANK ) GO TO 80
      NB=NB+1
   75 BUFFER(NB)=DCWORD(KK)
   80 NB=NB+1
      BUFFER(NB)=BLANK
   50 CONTINUE
      GO TO 500
  200 L1=IABS(L1)
      IF ( L2 .EQ. 0 ) GO TO 250
      L1=L1+BASE(2)-1
      IF ( L1 .LT. BASE(2) .OR. L1 .GE. BASE(3) ) GO TO 9998
      L2=L2+BASE(2)-1
      IF ( L2 .LT. BASE(2) .OR. L2 .GE. BASE(3) ) GO TO 9997
      ICOL=LINK(L2,10,2)
      IF ( ICOL .EQ. 0 ) GO TO 255
      LL=L1
      CALL TCHECK(LL)
      L1=LINK(LL,ICOL,1)
      L2=LINK(LL,ICOL,2)
      GO TO 40
  250 L1=L1+BASE(2)-1
      IF ( L1 .LT. BASE(2) .OR. L1 .GE. BASE(3) ) GO TO 9998
  255 CONTINUE
      CALL RANDU(NIX,NIY,X)
      NIX=NIY
      SUB=X*FLOAT(LINK(L1,10,1))+.5
      MAX=LINK(L1,10,1)
      IF ( SUB .GT. MAX ) SUB=MAX
      IF ( SUB .LT. 1 ) SUB=1
      IF ( SUB .EQ. LINK(L1,10,2) ) GO TO 255
      LL=L1
      CALL TCHECK(LL)
      L1=LINK(LL,SUB,1)
      L2=LINK(LL,SUB,2)
      LINK(LL,10,2)=SUB
      GO TO 40
  500 CONTINUE
  600 CALL PRINTO(K)
      SAVE=0
 1000 CONTINUE
      RETURN
 9997 WRITE (6,5) L2
      STOP
 9998 WRITE (6,4) L1
      STOP
 9999 WRITE (6,2) FORM
      STOP
    1 FORMAT (1H1,18A4//)
    2 FORMAT (33HOFORM CODE NUMBER IS OUT OF RANGE,I10)
    3 FORMAT (33HOITEM CODE NUMBER IS OUT OF RANGE,I10)
    4 FORMAT (48HORANDOM EXPRESSION SET POINTER 1 IS OUT OF RANGE,I10)
    5 FORMAT (48HORANDOM EXPRESSION SET POINTER 2 IS OUT OF RANGE,I10)
      END


SUBPROGRAMS

  BF:S6       BF:FI       BF:SF       BF:II       FLOAT       BF:FTI      BF:ITF
  IFIX        TCHECK      CTOF        DCOMPZ      COMPZ       BF:FTD      B47
  IABS        PRINTO      BF:SX       BF:SS       BF:SR

PROGRAM ALLOCATION
```

```
408.0       TESTS     40A.0       LNK        40C.0       DSGN       40D.0       BLANK
40F.0       SAVE      410.0       NSTR       411.0       T          0.0         NTESTS
413.0       K         0.0         NITEMS     414.0       X          415.0       ROW
417.0       IX        418.0       S1         419.0       S2         41A.0       NIY
41C.0       FORM      41D.0       N          41E.0       L1         41F.0       L2
422.0       TWORD     424.0       F          425.0       NREPS      426.0       TEMP
429.0       IDSTRB    42A.0       TX         42C.0       L11        42D.0       L22
42F.0       NC        430.0       LL         431.0       SUB        432.0       IMAX
434.0       KK        435.0       ICOL       436.0       MAX

437.0       DCWORD    43F.0       NWORD      0.0         ITEM       0.0         TITLE

/BLOCK1   / ALLOCATION 6979     WORDS

0.0         TEXT      4650.0      NT         4651.0      LINK


/BLOCK2   / ALLOCATION 3EA      WORDS

0.0         BUFFER    3E8.0       NB         3E9.0       NIX


/BLOCK3   / ALLOCATION 1A7      WORDS

0.0         BASE      3.0         B          7B.0        FT


/BLOCK4   / ALLOCATION 1CD      WORDS

0.0         REELS     4.0         NREELS     5.0         LTAPE      1C7.0       TSAVE
1C9.0       ITAPE



PROGRAM END
```

```
C     ************************************************************************
C
C      RNUMBR SUBPROGRAM -- SUPPLIES ALL RANDOM NUMBERS, FREQUENCY
C      DISTRIBUTIONS, PROBABILITY DISTRIBUTIONS, JOINT FREQUENCY
C      DISTRIBUTIONS AND JOINT PROBABILITY DISTRIBUTIONS.
C
C     ************************************************************************
      SUBROUTINE RNUMBR(NT,SAVE,NREPS,DISTRB,NPLACE)
      REAL*8 TEXT
      REAL*8 TWORD
      REAL*8 JOINT
      REAL*8 INTVL
      REAL*8 ZERO
      REAL*8 TEMP
      REAL*8 T
      REAL LIMIT,LL,KODE
      INTEGER CNTR,SUB,START,SWITCH,SAVE,OP,WIDTH,BASE,SKIP,DISTRB,OPI,
     1STOP
      COMMON /BLOCK1/ TEXT(9000),NTEXT,LINK(450,10,2)
      COMMON /BLOCK2/ BUFFER(1000),NB,NIX
      COMMON /BLOCK3/ BASE(3),B(120),FT(20,15)
      DIMENSION BCD(10),OPLIST(5),DCWORD(8),OP(3),SUB(3),T(4),LIMIT(2),
     1R(10),KODE(11),AREA(11,2),INTVL(11,2),JOINT(10,10),WORD(8)
      DATA BCD/'0','1','2','3','4','5','6','7','8','9'/
      DATA OPLIST/'*','/','-','+','E'/,BLANK/' '/
      IF ( DISTRB .NE. 0 ) GO TO (8000,8000,8999,8999),DISTRB
      N=NT
      DO 12 I=1,4
      TEMP=BCD(I)
      CALL B47(TEMP)
      IF ( TEXT(NT+4) .EQ. TEMP ) GO TO 15
12    CONTINUE
      NT=NT+4
      GO TO 16
15    SWITCH=I-1
      NT=NT+5
16    DO 10 I=1,4
      NN=N+I-1
10    T(I)=TEXT(NN)
      CALL CTOF(T(1),LIMIT(1),IF)
      CALL CTOF(T(3),LIMIT(2),IF)
      CNTR=0
      IF ( SWITCH .EQ. 0 ) SAVE=0
      IF ( SWITCH .NE. 0 ) CNTR=SAVE
      T(1)=T(2)
      T(3)=T(2)
      T(2)=T(4)
      ZERO=BCD(1)
      CALL B47(ZERO)
      SKIP=0
      IF ( T(1) .EQ. ZERO .AND. T(2) .EQ. ZERO ) SKIP=1
      IF ( T(1) .EQ. ZERO .AND. T(2) .NE. ZERO ) GO TO 25
      IF ( T(1) .NE. ZERO .AND. T(2) .EQ. ZERO ) GO TO 30
      GO TO 35
25    START=1
      STOP=1
      GO TO 45
30    START=2
      STOP=2
      GO TO 45
35    START=1
      STOP=2
45    IF ( NREPS .EQ. 1 ) GO TO 50
      NB=NB+1
      BUFFER(NB)=BLANK
50    DO 7000 JK=1,NREPS
      IF ( SKIP .EQ. 1 ) GO TO 5999
      DO 5000 II=START,STOP
      CALL DCOMPZ(1,T(II),DCWORD)
      TEMP=DCWORD(2)
      CALL B47(TEMP)
      CALL CTOF(TEMP,F,SUB(1))
      TEMP=DCWORD(4)
      CALL B47(TEMP)
      CALL CTOF(TEMP,F,SUB(2))
      TEMP=DCWORD(6)
      CALL B47(TEMP)
      CALL CTOF(TEMP,F,SUB(3))
      DCWORD(2)=DCWORD(3)
      DCWORD(3)=DCWORD(5)
      DO 75 I=1,3
      OP(I)=0
      DO 75 J=1,5
      IF ( OPLIST(J) .EQ. DCWORD(I) ) OP(I)=J
75    CONTINUE
      LL=LIMIT(II)
      DO 1000 I=1,3
      IF ( OP(I) .EQ. 0 ) GO TO 3000
      JJ=SUB(I)
      OPI=OP(I)
      GO TO (100,200,300,400,500),OPI
100   LL=LL*R(JJ)
      GO TO 1000
200   LL=LL/R(JJ)
      GO TO 1000
300   LL=LL-R(JJ)
      GO TO 1000
400   LL=LL+R(JJ)
      GO TO 1000
500   EXPT=R(JJ)
      LL=LL**EXPT
1000  CONTINUE
3000  LIMIT(II)=LL
5000  CONTINUE
5999  CONTINUE
      CALL RANDU(NIX,NIY,X)
      NIX=NIY
      X=X+.005
      LL        =LIMIT(1)+X*ABS(LIMIT(1)-LIMIT(2))+5./(10.**(NPLACE+1))
      N=SWITCH+1
      IF ( N .GT. 4 .OR. N .LT. 1 ) N=1
      GO TO (6000,6001,6002,6003),N
6000  CALL FTOC(LL        ,KODE)
      DO 6400 I=1,5
      IF ( KODE(I) .EQ. BCD(I) ) GO TO 6400
      START=I
      GO TO 6455
6400  CONTINUE
      START=6
      IF ( NPLACE .EQ. 0 ) START=5
6455  NP=6+NPLACE
      IF ( NPLACE .EQ. 0 ) NP=5
      DO 6500 I=START,NP
      NB=NB+1
6500  BUFFER(NB)=KODE(I)
      NB=NB+1
      BUFFER(NB)=BLANK
      GO TO 7000
6001  CNTR=CNTR+1
      R(CNTR)=LL
      SAVE=CNTR
      GO TO 6000
6002  CNTR=CNTR+1
      R(CNTR)=LL
      SAVE=CNTR
      GO TO 7000
6003  SAVE=CNTR
      GO TO 6000
7000  CONTINUE
      RETURN
```

```
8000 CALL DCOMPZ(1,TEXT(NT),DCWORD)
     NT=NT+1
     TEMP=DCWORD(4)
     CALL B47(TEMP)
     CALL CTOF(TEMP,F,START)
     TEMP=DCWORD(5)
     CALL B47(TEMP)
     CALL CTOF(TEMP,F,WIDTH)
     TEMP=DCWORD(6)
     CALL B47(TEMP)
     CALL CTOF(TEMP,F,NL)
     DO 8050 II=4,8
8050 DCWORD(II)=BLANK
     CALL COMPZ(8,DCWORD,TWORD)
     CALL CTOF(TWORD,F,N)
     N1=START
     DO 8100 I=1,NL
     N2=N1+WIDTH-1
     TEMP=B(N1)
     CALL B47(TEMP)
     CALL DCOMPZ(1,TEMP,WORD)
     WORD(3)=OPLIST(3)
     TEMP=B(N2)
     CALL B47(TEMP)
     CALL DCOMPZ(1,TEMP,DCWORD)
     WORD(4)=DCWORD(1)
     WORD(5)=DCWORD(2)
     WORD(6)=BLANK
     WORD(7)=BLANK
     WORD(8)=BLANK
     K=NL-I+1
     CALL COMPZ(8,WORD,INTVL(K,1))
8100 N1=N2+1
     AREA(1,1)=-3.
     STEP=6./FLOAT(NL)
     STOP =NL+1
     DO 8200 I=2,STOP
8200 AREA(I,1)=AREA(I-1,1)+STEP
     DO 8250 I=1,STOP
     EXPT=-AREA(I,1)*AREA(I,1)/2.
8250 AREA(I,1)=(1./SQRT(2.*3.1416))*2.7184**EXPT
     DO 8275 I=1,NL
8275 AREA(I,1)=((AREA(I,1)+AREA(I+1,1))/2.)*STEP
     IF ( DISTRB .EQ. 1      . ) GO TO 8295
     SUM=0.
     DO 8290 I=1,NL
     AREA(I,1)=IFIX(AREA(I,1)*FLOAT(N)+.5)
8290 SUM=SUM+AREA(I,1)
     ISUB=FLOAT(NL)/2.+.5
     AREA(ISUB,1)=AREA(ISUB,1)+(FLOAT(N)-SUM)+.5
     GO TO 8280
8295 IF ( NPLACE .NE. 0 ) GO TO 8298
     WRITE (6,8)
     NPLACE=3
8298 SHIFT=10.**NPLACE
     SUM=0.
     DO 8296 I=1,NL
     AREA(I,1)=IFIX(AREA(I,1)*SHIFT+.5)
8296 SUM=SUM+AREA(I,1)
     ISUB=FLOAT(NL)/2.+.5
     AREA(ISUB,1)=AREA(ISUB,1)+(SHIFT-SUM)+.5
     DO 8297 I=1,NL
```

```
8297 AREA(I,1)=AREA(I,1)/SHIFT+5.0/(SHIFT*10.)
     SUM=0.
     DO 8299 I=1,NL
8299 SUM=SUM+AREA(I,1)
     DIFF=1.-SUM
     AREA(ISUB,1)=AREA(ISUB,1)+DIFF*1./SHIFT
8280 BUFFER(NB)=BLANK
     NB=NB+1
     DO 8300 I=1,NL
     CALL DCOMPZ(1,INTVL(I,1),DCWORD)
     DO 8350 J=1,5
     BUFFER(NB)=DCWORD(J)
8350 NB=NB+1
     CALL FTOC(AREA(I,1),KODE)
     IF ( DISTRB .EQ. 1       ) GO TO 8390
     DO 8360 J=1,5
     IF ( KODE(J) .NE. BCD(1) ) GO TO 8370
8360 KODE(J)=BLANK
8370 DO 8380 J=1,5
     BUFFER(NB)=KODE(J)
8380 NB=NB+1
     GO TO 8300
8390 NP=6+NPLACE
     IF ( NP .GT. 6 ) GO TO 8395
8392 WRITE (6,8)
     NP=9
8395 NP1=NP+1
     DO 8396 K=NP1,10
8396 KODE(K)=BLANK
     DO 8400 J=6,10
     BUFFER(NB)=KODE(J)
8400 NB=NB+1
8300 CONTINUE
     NB=NB-1
     RETURN
8999 CALL DCOMPZ(1,TEXT(NT),DCWORD)
     NT=NT+1
     DO 9000 I=1,6
     TEMP=DCWORD(I)
     CALL B47(TEMP)
9000 CALL CTOF(TEMP,KODE(I),NNNN)
     DO 9001 I=1,4,3
     K=1
     IF ( I .GT. 2 ) K=2
     N1=KODE(I)
     NL=KODE(I+2)
     DO 9001 J=1,NL
     N2=FLOAT(N1)+KODE(I+1)-1.
     TEMP=B(N1)
     CALL B47(TEMP)
     CALL DCOMPZ(1,TEMP,WORD)
     WORD(3)=OPLIST(3)
     TEMP=B(N2)
     CALL B47(TEMP)
     CALL DCOMPZ(1,TEMP,DCWORD)
     WORD(4)=DCWORD(1)
     WORD(5)=DCWORD(2)
     WORD(6)=BLANK
     WORD(7)=BLANK
     WORD(8)=BLANK
     IF ( K .EQ. 1 ) L=NL-J+1
     IF ( K .EQ. 2 ) L=J
```

```
      CALL COMPZ(8,WORD,INTVL(L,K))
 9001 N1=N2+1
      AREA(1,1)=-3.
      AREA(1,2)=-3.
      DO 9005 I=1,4,3
      K=1
      IF ( I .GT. 2 ) K=2
      STEP=6./KODE(I+2)
      STOP=KODE(I+2)+1.
      DO 9006 J=2,STOP
 9006 AREA(J,K)=AREA(J-1,K)+STEP
      DO 9008 J=1,STOP
      EXPT=-AREA(J,K)*AREA(J,K)/2.
 9008 AREA(J,K)=(1./SQRT(2.*3.1416))*2.7184**EXPT
      NN=KODE(I+2)
      DO 9009 J=1,NN
 9009 AREA(J,K)=((AREA(J,K)+AREA(J+1,K))/2.)*STEP
 9005 CONTINUE
      CALL RANDU(NIX,NIY,X)
      NIX=NIY
      NTOTAL=((200.+X*100.)/10.)+.5
      NTOTAL=NTOTAL*10
      NL1=KODE(3)
      NL2=KODE(6)
      SUM=0.
      ISUB1=FLOAT(NL1)/2.+.5
      ISUB2=FLOAT(NL2)/2.+.5
      XX=AREA(ISUB1,1)*AREA(ISUB2,2)
      IF ( DISTRB .EQ. 4 ) XX=XX*FLOAT(NTOTAL)
      DO 9500 I=1,NL1
      DO 9500 J=1,NL2
      X=AREA(I,1)*AREA(J,2)
      IF ( DISTRB .EQ. 4       ) X=X*FLOAT(NTOTAL)
      SUM=SUM+X
      CALL FTOC(X,KODE)
      DO 9550 L=1,5
      IF ( DISTRB .EQ. 3       ) GO TO 9600
      DCWORD(L)=KODE(L)
      GO TO 9550
 9600 DCWORD(L)=KODE(L+5)
 9550 CONTINUE
      DCWORD(6)=BLANK
      DCWORD(7)=BLANK
      DCWORD(8)=BLANK
      CALL COMPZ(8,DCWORD,JOINT(I,J))
 9500 CONTINUE
      IF ( DISTRB .EQ. 4 ) XX=XX+FLOAT(NTOTAL)-SUM
      IF ( DISTRB .EQ. 3 ) XX=XX+1.-SUM+1./(10.**NPLACE)
      CALL FTOC(XX,KODE)
      DO 9010 L=1,5
      IF ( DISTRB .EQ. 3 ) GO TO 9015
      DCWORD(L)=KODE(L)
      GO TO 9010
 9015 DCWORD(L)=KODE(L+5)
 9010 CONTINUE
      DCWORD(6)=BLANK
      DCWORD(7)=BLANK
      DCWORD(8)=BLANK
      CALL COMPZ(8,DCWORD,JOINT(ISUB1,ISUB2))
      BUFFER(NB)=BLANK
      NB=NB+1
      DO 9700 I=1,NL1
      CALL DCOMPZ(1,INTVL(I,1),DCWORD)
      DO 9704 J=1,5
      BUFFER(NB)=DCWORD(J)
 9704 NB=NB+1
      DO 9710 J=1,NL2
      CALL DCOMPZ(1,JOINT(I,J),DCWORD)
      IF ( DISTRB .EQ. 4 ) GO TO 9707
      IF ( NPLACE .NE. 0 ) GO TO 9705
      WRITE (6,8)
      NPLACE=3
 9705 NP=NPLACE+1
      GO TO 9701
 9707 DO 9708 K=1,4
      IF ( DCWORD(K) .NE. BCD(1) ) GO TO 9709
 9708 DCWORD(K)=BLANK
 9709 NP=5
 9701 NP1=NP+1
      DO 9716 K=NP1,5
 9716 DCWORD(K)=BLANK
      DO 9715 K=1,5
      BUFFER(NB)=DCWORD(K)
 9715 NB=NB+1
 9710 CONTINUE
 9700 CONTINUE
      NL22=NL2+2
      DO 9720 M=1,NL22
      DO 9720 I=1,5
      BUFFER(NB)=BLANK
 9720 NB=NB+1
      DO 9725 I=1,NL2
      CALL DCOMPZ(1,INTVL(I,2),DCWORD)
      DO 9730 J=1,5
      BUFFER(NB)=DCWORD(J)
 9730 NB=NB+1
 9725 CONTINUE
      NB=NB-1
      RETURN
 8    FORMAT (51H1NUMBER OF DIGITS REQUESTED IN PROBABILITY IS ZERO.//
     141H0PROGRAM WILL CONTINUE WITH THREE DIGITS.,/1H1)
      END


SUBPROGRAMS

  BF:SG        BF:FTD      B47          CTOF         DCOMPZ       BF:FR        RANDU
  BF:FN        FTOC        COMPZ        FLOAT        SQRT         IFIX         BF:ITF
  BF:S6        BF:SF       BF:SS        BF:SR

PROGRAM ALLOCATION

8FC.0      RNUMBR    8FD.0      BLANK      0.0        DISTRB     8FE.0      N          0
8FF.0      I         900.0      TEMP       902.0      SWITCH     903.0      NN         9
905.0      CNTR      0.0        SAVE       906.0      ZERO       908.0      SKIP       9
90A.0      STOP      0.0        NREPS      90B.0      JK         90C.0      II         9
90E.0      J         90F.0      LL         910.0      JJ         911.0      BPI        9
913.0      NIY       914.0      X          0.0        NPLACE     915.0      NP         9
917.0      NL        918.0      TWORD      91A.0      N1         91B.0      N2         9
91D.0      STEP      91E.0      SUM        91F.0      ISUB       920.0      SHIFT      9
922.0      NP1       923.0      NNNN       924.0      L          925.0      NTOTAL     9
927.0      NL2       928.0      ISUB1      929.0      ISUB2      92A.0      XX         9
92C.0      M
```

```
92D.0      BCD      937.0     OPLIST    93C.0     DCWORD    944.0     OP        9
94A.0      T        952.0     LIMIT     954.0     R         95E.0     KODE      9
980.0      INTVL    9AC.0     JOINT     A74.0     WORD

/BLOCK1  / ALLOCATION 6979    WORDS

0.0        TEXT     4650.0    NTEXT     4651.0    LINK


/BLOCK2  / ALLOCATION 3EA     WORDS

0.0        BUFFER   3E8.0     NB        3E9.0     NIX


/BLOCK3  / ALLOCATION 1A7     WORDS

0.0        BASE     3.0       B         7B.0      FT




PROGRAM END


    C      ************************************************************
    C
    C       FTOC SUBPROGRAM -- CONVERTS REAL OR INTEGER NUMBER INTO
    C       ALPHANUMERIC EQUIVALENT.
    C
    C      ************************************************************
           SUBROUTINE FTOC(F,KODE)
           INTEGER C
           REAL KODE,IPNT,MINUS
           DIMENSION KODE(11),RAD(5),BCD(10)
           DATA RAD/10000.,1000.,100.,10.,1./
           DATA BCD/'0','1','2','3','4','5','6','7','8','9'/
           DATA IPNT,MINUS/'.','-'/
           S=1.
           IF ( F .LT. 0. ) S=-1.
           F=F*S
           IF ( F .GT. .00001 ) GO TO 50
           DO 40 I=1,11
      40   KODE(I)=BCD(1)
           KODE(6)=IPNT
           RETURN
      50   KODE(6)=IPNT
           IF=F
           T=IF
           R=F-T
           C=0
           DO 100 I=1,2
           DO 200 J=1,5
           C=C+1
           T=FLOAT(IF)/RAD(J)
           IT=T
           KODE(C)=IT
      IF=(T-KODE(C))*RAD(J)+.5
  200 CONTINUE
      C=C+1
      IF=R*100000.
  100 CONTINUE
      DO 300 I=1,11
      DO 300 J=1,10
      FJ=J-1
      IF ( KODE(I).EQ.FJ) KODE(I)=BCD(J)
  300 CONTINUE
      IF ( S .EQ. 1. ) GO TO 500
      DO 400 I=1,5
      IF ( KODE(I) .NE. BCD(1) ) GO TO 450
  400 CONTINUE
      I=6
  450 KODE(I-1)=MINUS
  500 RETURN
      END
```

```
SUBPROGRAMS

 BF!FTI     BF!ITF     FLOAT      BF!SS      BF!SR

PROGRAM ALLOCATION

E6.0     FTOC     E7.0     IPNT     E8.0     MINUS    E9.0     S        C
EA.0     I        EB.0     IF       EC.0     T        ED.0     R        E
EF.0     J        F0.0     IT       F1.0     FJ

0.0      KODE     F2.0     RAD      F7.0     BCD


PROGRAM END
```

```
      BLOCK DATA
      INTEGER BASE,REELS,TSAVE
      COMMON /BLOCK3/ BASE(3),B(120),FT(20,15)
      COMMON /BLOCK4/ REELS(4),NREELS,LTAPE(450),TSAVE,NSAVE,ITAPE(4)
      DATA B(1),B(2),B(3),B(4),B(5),B(6),B(7),B(8),B(9),B(10)            /
     1'01','02','03','04','05','06','07','08','09','10'/
      DATA B(11),B(12),B(13),B(14),B(15),B(16),B(17),B(18),B(19),B(20) /
     1'11','12','13','14','15','16','17','18','19','20'/
      DATA B(21),B(22),B(23),B(24),B(25),B(26),B(27),B(28),B(29),B(30) /
     1'21','22','23','24','25','26','27','28','29','30'/
      DATA B(31),B(32),B(33),B(34),B(35),B(36),B(37),B(38),B(39),B(40) /
     1'31','32','33','34','35','36','37','38','39','40'/
      DATA B(41),B(42),B(43),B(44),B(45),B(46),B(47),B(48),B(49),B(50) /
     1'41','42','43','44','45','46','47','48','49','50'/
      DATA B(51),B(52),B(53),B(54),B(55),B(56),B(57),B(58),B(59),B(60) /
     1'51','52','53','54','55','56','57','58','59','60'/
      DATA B(61),B(62),B(63),B(64),B(65),B(66),B(67),B(68),B(69),B(70) /
     1'61','62','63','64','65','66','67','68','69','70'/
      DATA B(71),B(72),B(73),B(74),B(75),B(76),B(77),B(78),B(79),B(80) /
     1'71','72','73','74','75','76','77','78','79','80'/
      DATA B(81),B(82),B(83),B(84),B(85),B(86),B(87),B(88),B(89),B(90) /
     1'81','82','83','84','85','86','87','88','89','90'/
```

```
      DATA B(91),B(92),B(93),B(94),B(95),B(96),B(97),B(98),B(99),B(100)/
     1'91','92','93','94','95','96','97','98','99','100'/
      DATA B(101),B(102),B(103),B(104),B(105),B(106),B(107),B(108),
     1      B(109),B(110)                /
     2'101','102','103','104','105','106','107','108','109','110'/
      DATA B(111),B(112),B(113),B(114),B(115),B(116),B(117),B(118),
     1      B(119),B(120)                /
     2'111','112','113','114','115','116','117','118','119','120'/
      DATA REELS/1,2,3,4/
      END

SUBPROGRAMS

  BF:SX

PROGRAM ALLOCATION




/BLOCK3  / ALLOCATION 1A7     WORDS

0.0         BASE      3.0       B          7B.0       FT


/BLOCK4  / ALLOCATION 1CD     WORDS

0.0         REELS     4.0       NREELS     5.0        LTAPE     1C7.0      TSAVE     1
1C9.0       ITAPE




PROGRAM END
```

```
C     **************************************************************
C
C      TCHECK SUBPROGRAM -- LOADS CONTENTS OF APPROPRIATE TAPE INTO
C      CORE DURING EXECUTION OF EACH ITEM FORM.
C
C     **************************************************************
      SUBROUTINE TCHECK(N)
      REAL*8 TEXT
      INTEGER REELS,TSAVE
      COMMON /BLOCK1/ TEXT(9000),NT,LINK(450,10,2)
      COMMON /BLOCK4/ REELS(4),NREELS,LTAPE(450),TSAVE,NSAVE,ITAPE(4)
      NSAVE=N
      IF ( LTAPE(N) .EQ. TSAVE ) GO TO 100
      TSAVE=LTAPE(N)
      REWIND TSAVE
      READ (TSAVE) NT,(TEXT(I),I=1,NT)
  100 RETURN
      END
```

```
SUBPROGRAMS

 BF!ST      BF!S2      BF!II      BF!DI      BF!SF      BF!SS      BF!SR.

PROGRAM ALLOCATION

4A.0        TCHECK   0.0        N          4B.0       I



/BLOCK1  / ALLOCATION 6979    WORDS

0.0         TEXT      4650.0    NT         4651.0     LINK



/BLOCK4  / ALLOCATION 1CD     WORDS

0.0         REELS     4.0       NREELS     5.0        LTAPE .   1C7.0     TSAVE.    1
1C9.0       ITAPE




PROGRAM END
```

```
C       ***********************************************************
C
C        CTOF SUBPROGRAM -- CONVERTS AN ALPHANUMERIC NUMBER INTO.A REAL
C        AND INTEGER EQUIVALENT.
C
C       ***********************************************************
        SUBROUTINE CTOF(WORD,F,N)
        REAL*8 WORD
        REAL MINUS,IPNT
        DIMENSION R(17),BCD(10),DCWORD(8)
        DATA MINUS,IPNT,BLANK/'-','.',' '/
        DATA BCD/'0','1','2','3','4','5','6','7','8','9'/
        DATA R/10000000.,1000000.,100000.,10000.,1000.,100.,10.,1.,0.,
       1.1,.01,.001,.0001,.00001,.000001,.0000001,.00000001/
        CALL DCOMPZ(1,WORD,DCWORD)
        FMINUS=1.
        IF ( DCWORD(1) .NE. MINUS ) GO TO 15
        FMINUS=-1.
        DCWORD(1)=BCD(1)
  15    NP=0
        DO 20 I=1,6
        IF ( DCWORD(I) .NE. IPNT ) GO TO 20
        NP=I
        GO TO 50
  20    CONTINUE
        DO 30 I=1,8
        J=8-I+1
        IF ( DCWORD(J) .NE. BLANK ) GO TO 40
  30    NP=NP+1
  40    NP=8-NP+1
```

```
 50    DO 55 I=1,8
       IF ( DCWORD(I) .EQ. BLANK ) DCWORD(I)=BCD(1)
 55    CONTINUE
 60    DO 70 I=1,8
       DO 70 J=1,10
       IF ( DCWORD(I) .EQ. BCD(J) ) DCWORD(I)=J-1
 70    CONTINUE
       N1=9-(7-(8-NP))
       N2=N1+7
       DCWORD(NP)=0
       F=0.
       J=0
       DO 80 I=N1,N2
       J=J+1
 80    F=F+DCWORD(J)*R(I)
       F=F*FMINUS
       N=F
       RETURN
       END

SUBPROGRAMS

 DCOMPZ      BF:ITF      BF:FTI      BF:SS       BF:SR

PROGRAM ALLOCATION

E8.0      CTOF      E9.0      MINUS     EA.0      IPNT      EB.0      BLANK     0
EC.C.     FMINUS    ED.0      NP        EE.0      I         EF.0      J         F
F1.0      N2        0.0       F         0.0       N

F2.0      R         103.0     BCD       10D.0     DCWORD


PROGRAM END



  C       ******************************************************************
  C
  C        B47 SUBPROGRAM -- LOADS ALPHANUMERIC BLANKS INTO BYTES 4-7 OF
  C        DOUBLEWORD.
  C
  C       ******************************************************************
          SUBROUTINE B47(WORD)
          REAL*8 WORD
          DATA BLANK/' '/
          CALL D2S(WORD,W1,W2)
          DO 100 I=1,4
          J=I-1
   100    CALL PKONE(BLANK,0,W2,J)
          CALL DBL (W1,W2,WORD)
          RETURN
          END

 SUBPROGRAMS

  D2S        PKONE       DBL         BF:SS       BF:SR
```

```
PROGRAM ALLOCATION

3C.0        B47        3D.0        BLANK     0.0         WORD       3E.0        W1                3
40.0        I          41.0        J




PROGRAM END
```

```
C        ****************************************************************************
C
C         DCOMPZ SUBPROGRAM -- PERFORMS DECOMPOSITION OF DOUBLEWORD
C         INTO 8 BYTES.
C
C        ****************************************************************************
         SUBROUTINE DCOMPZ(N,WORD,DCWORD)
         REAL*8 WORD
         DIMENSION DCWORD(8)
         DATA BLANK/'    '/
         DO 10  I= 1,8
   10    DCWORD(I)=BLANK
         CALL D2S(WORD,W1,W2)
         DO 100 I= 1,4
         J=I-1
  100    CALL PKONE(W1,J,DCWORD(I),0)
         DO 200 I=5,8
         J=I-5
  200    CALL PKONE(W2,J,DCWOPD(I),0)
         RETURN
         END
```

```
SUBPROGRAMS

 D2S           PKONE         BF!SS         BF!SR

PROGRAM ALLOCATION

66.0       DCOMPZ    67.0        BLANK     68.0     I           0.0          WORD         6.
6A.0       W2        6B.0        J         0.0      N

0.0        DCWORD



PROGRAM END
```

```
C        ****************************************************************************
C
C         COMPZ SUBPROGRAM -- COMPOSES FIRST BYTE OF 8 SINGLEWORDS INTO
C         ONE DOUBLEWORD.
```

```
      C
      C       *********************************************************************
              SUBROUTINE COMPZ(N,WORD,OUT)
              REAL *8 OUT
              DIMENSION WORD(10)
              DO 100 I=1,4
              J=I-1
          100 CALL PKONE(WORD(I),0,W1,J)
              DO 200 I=5,8
              J=I-5
          200 CALL PKONE(WORD(I),0,W2,J)
              CALL DBL(W1,W2,OUT)
              RETURN
              END
```

```
SUBPROGRAMS

  PKONE       DBL          BF:SS       BF:SR

PROGRAM ALLOCATION

58.0        COMPZ     59.0     I          5A.0      J          5B.0      W1          5
0.0         OUT       0.0      N

0.0         WORD


PROGRAM END
```

```
                                                    PACK AND UNPACK ROUTINE
                         *
                                    DEF      PKONE
    0000000D             LR         EQU      13
    00000001             A          EQU      1
    00000002             B          EQU      2
    00000003             AC         EQU      3
    00000004             NA         EQU      4
    00000005             NB         EQU      5
    00000005             NREGS      EQU      5
000      02200050   A    PKONE      LCI      NREGS
001      8B100000   A               PSM,1    *0
002      20D00001   A               AI,LR    1
003      B210000D   A               LW,A     *LR
004      20D00001   A               AI,LR    1
005      B240000D   A               LW,NA    *LR
006      B2400004   A               LW,NA    *NA
007      20D00001   A               AI,LR    1
008      B220000D   A               LW,B     *LR
009      20D00001   A               AI,LR    1
00A      B250000D   A               LW,NB    *LR
00B      B2500005   A               LW,NB    *NB
00C      F2380001   A               LB,AC    *A,NA
00D      F53A0002   A               STB,AC   *B,NB
00E      02200050   A               LCI      NREGS
00F      8A100000   A               PLM,1    *0
010      20D00001   A               AI,LR    1
011      E800000D   A               B        *LR
```

```
                                             END
ICTIONARY
       00000001
       00000003
       00000002
       0000000D
       00000004
       00000005
       00000005
       00000000



                                  *                      DOUBLE TO SINGLE WORDS ROUTINE
                                             DEF        D2S
       0000000D                   LR         EQU        13
       00000002                   C          EQU        2
       00000003                   D          EQU        3
       00000004                   E          EQU        4
       00000004                   NREGS      EQU        4
00000       02200040     A        D2S        LCI        NREGS
00001       8B100000     A                   PSM,1      *0
00002       20D00001     A                   AI,LR      1
00003       B240000D     A                   LW,E       *LR
00004       12280000     A                   LD,C       0,E
00005       20D00001     A                   AI,LR      1
00006       B240000D     A                   LW,E       *LR
00007       B5200004     A                   STW:C      *E
00008       20D00001     A                   AI,LR      1
00009       B240000D     A                   LW,E       *LR
0000A       B5300004     A                   STW,D      *E
0000B       02200040     A                   LCI        NREGS
0000C       8A100000     A                   PLM,1      *0
0000D       20D00001     A                   AI,LR      1
0000E       E800000D     A                   B          *LR
                                             END
DICTIONARY
       00000002
       00000003
       00000
       00000004
       0000000D
       00000004



                                  *                      SINGLE TO DOUBLEWORD ROUTINE
                                             DEF        DBL
       0000000D                   LR         EQU        13
       00000002                   A          EQU        2
       00000003                   B          EQU        3
       00000004                   C          EQU        4
       00000004                   NREGS      EQU        4
00000       02200040     A        DBL        LCI        NREGS
00001       8B100000     A                   PSM,1      *0
00002       20D00001     A                   AI,LR      1
00003       B220000D     A                   LW,A       *LR
00004       B2200002     A                   LW,A       *A
00005       20D00001     A                   AI,LR      1
00006       B230000D     A                   LW,B       *LR
00007       B2300003     A                   LW,B       *B
00008       20D00001     A                   AI,LR      1
```

```
00009      8240000D  A              LW,C      *LR
0000A      15230000  A              STD,A     0,C
0000B      02200040  A              LCI       NREGS
0000C      8A100000  A              PLM,1     *0
0000D      20D00001  A              AI,LR     1
0000E      E800000D  A              B         *LR
                                    END
ICTIØNARY
     00000002
     00000003
     00000004
     00000
     0000000D
     00000004
```

```
C
C     ..................................................................
C
C        SUBRØUTINE RANDU
C
C        PURPØSE
C           CØMPUTES UNIFØRMLY DISTRIBUTED RANDØM REAL NUMBERS BETWEEN
C           0 AND 1.0 AND RANDØM INTEGERS BETWEEN ZERØ AND
C           2**31. EACH ENTRY USES AS INPUT AN INTEGER RANDØM NUMBER
C           AND PRØDUCES A NEW INTEGER AND REAL RANDØM NUMBER.
C
C        USAGE
C           CALL RANDU(IX,IY,YFL)
C
C        DESCRIPTIØN ØF PARAMETERS
C           IX - FØR THE FIRST ENTRY THIS MUST CØNTAIN ANY ØDD INTEGER
C                NUMBER WITH NINE ØR LESS DIGITS. AFTER THE FIRST ENTRY,
C                IX SHØULD BE THE PREVIØUS VALUE ØF IY CØMPUTED BY THIS
C                SUBRØUTINE.
C           IY - A RESULTANT INTEGER RANDØM NUMBER REQUIRED FØR THE NEX
C                ENTRY TØ THIS SUBRØUTINE. THE RANGE ØF THIS NUMBER IS
C                BETWEEN ZERØ AND 2**31
C           YFL- THE RESULTANT UNIFØRMLY DISTRIBUTED, FLØATING PØINT,
C                RANDØM NUMBER IN THE RANGE 0 TØ 1.0
C
C        REMARKS
C           THIS SUBRØUTINE IS SPECIFIC TØ SYSTEM/360
C           THIS SUBRØUTINE WILL PRØDUCE 2**29 TERMS
C           BEFØRE REPEATING
C
C        SUBRØUTINES AND FUNCTIØN SUBPRØGRAMS REQUIRED
C           NØNE
C
C        METHØD
C           PØWER RESIDUE METHØD DISCUSSED IN IBM MANUAL C20-8011,
C           RANDØM NUMBER GENERATIØN AND TESTING
C
C     ..................................................................
C
      SUBRØUTINE RANDU(IX,IY,YFL)
      IY=IX*65539
      IF(IY)5,6,6
    5 IY=IY+2147483647+1
    6 YFL=IY
      YFL=YFL*.4656613E-9
```

```
              RETURN
              END


   SUBPROGRAMS

     BF:ITF      BF:SS       BF:SR

   PROGRAM ALLOCATION

   42.0       RANDU    0.0        IY       0.0       IX       0.0      YFL




   PROGRAM END



 (MAP)

        BF:DDIR
        BF:DDOR
        BF:OHFOR
60 0    M:C
66 0    M:OC
6C 0    M:LO
72 0    M:LL
78 0    M:DO
7E 0    M:PO
84 0    M:BO
8A 0    M:LI
90 0    M:SI
96 0    M:BI
00 0    LOWEST LOC
12 0    BLOCK1
02 0    M:LDRST
8C 0    BLOCK2
76 0    BLOCK3
E 0     BLOCK4
80 0    MAKTXT
8A 0    PRINTO
25 0    TESTS
4A 0    RNUMBR
02 0    FTOC
48 0    TCHECK
25 0    CTOF
A0 0    B47
01 0    DCOMPZ
0 0     COMPZ
8 0     PKONE
9A 0    D2S
A 0     DSL
08 0    RANDU
00 0    BF:PIN
E 0     BF:TRP
A 0     BF:TRC
4C 0    IFIX
0 0     FLOAT
0 0     FLOATF
54 0    BF:S8
```

APPENDIX G

NO. 1

GIVEN THE FOLLOWING SETS WHERE U = A CUP B CUP C CUP D.

A = (PAMELA SUSAN ALICE JANE SALLY)

B = (SUSAN PAMELA ALICE BETH KATE)

C = (ANN BETH KATE MARY)

D = (SALLY KATE MARY SUSAN ANN)

LIST THE ELEMENTS IN THE FOLLOWING SET WHERE CAP MEANS SET INTERSECTION, CUP MEANS SET UNION AND ANOT MEANS ALL ELEMENTS NOT IN SET A.

A CAP (BNOT CUP (CNOT CAP D))

NO. 2

GIVEN THE FOLLOWING SETS WHERE U = A CUP B CUP C CUP D.

A = (W/W IS AN INTEGER, 1 .LE. W .LE. 7)

B = (X/X IS AN INTEGER, 2 .LE. X .LE. 8)

C = (Y/Y IS AN INTEGER, 2 .LE. Y .LE. 7)

D = (Z/Z IS AN INTEGER, 4 .LE. Z .LE. 10)

NOTE THAT .LE. MEANS LESS OR EQUAL TO. LIST THE ELEMENTS IN THE FOLLOWING SET WHERE CAP MEANS SET INTERSECTION, CUP MEANS SET UNION AND ANOT MEANS ALL ELEMENTS NOT IN SET A.

A CAP (B CUP C CUP D)

NO. 3

A SURVEY OF 498 STUDENTS TAKING ONE OR MORE COURSES IN ALGEBRA, PHYSICS OR STATISTICS REVEALED THAT THE FOLLOWING NUMBERS OF STUDENTS WERE TAKING THE INDICATED SUBJECTS. NOTE THAT THE DATA GIVEN INCLUDES THE TOTAL NUMBER OF STUDENTS WHO ARE TAKING THE INDICATED COURSE OR COMBINATION OF COURSES REGARDLESS OF WHAT OTHER COURSES THEY MAY BE TAKING.

ALGEBRA 120

ALGEBRA AND STATISTICS 66

PHYSICS 113

ALGEBRA AND PHYSICS 69

STATISTICS 115

PHYSICS AND STATISTICS 72

ALGEBRA, PHYSICS AND STATISTICS 43

COMPUTE THE NUMBER OF STUDENTS WHO ARE TAKING EITHER PHYSICS OR STATISTICS BUT NOT ALGEBRA.

NO. 4

PROVE THAT THE LEFT SIDE IS EQUAL TO THE RIGHT SIDE IN THE FOLLOWING SET EXPRESSION WHERE CAP MEANS SET INTERSECTION, CUP MEANS SET UNION AND ANOT MEANS ALL ELEMENTS NOT IN SET A.

(A CAP B) CUP (B CAP C) = (B CUP C) CAP A

NO. 5

GIVEN THE FOLLOWING SETS.

A= (ANN BETH KATE MARY)

B= (HENRY WILLIAM RICHARD SAM)

LIST THE ELEMENTS IN THE SET PRODUCT AXB.

NO. 6

GIVEN THE FOLLOWING SETS.

A= (SALLY KATE MARY SUSAN ANN)

B= (JAMES RICHARD HENRY THOMAS)

GRAPH THE ELEMENTS IN THE SET PRODUCT AXB.

NO. 7

GIVEN THE FOLLOWING SETS.

A = (X / X IS AN INTEGER, 4 .LE. X .LE. 9)

B = (Y / Y IS AN INTEGER, 2 .LE. Y .LE. 6)

WHERE .LE. MEANS LESS THAN OR EQUAL TO. LIST THE ELEMENTS IN THE SET PRODUCT AXB.

NO. 8

GIVEN THE FOLLOWING SETS.

A = (X / X IS AN INTEGER, 4 .LE. X .LE. 8)

B = (Y / Y IS AN INTEGER, 4 .LE. Y .LE. 8)

WHERE .LE. MEANS LESS THAN OR EQUAL TO. GRAPH THE SET PRODUCT.

NO. 9

GIVEN THE FOLLOWING SETS.

A= (ANN BETH KATE MARY)

B= (JOHN ROBERT HENRY STEVE)

CONSIDERING THE SET PRODUCT AXB LIST THE ELEMENTS IN THE RELATION,
'BOTH NAMES END WITH THE SAME LETTER'

NO. 10

GIVEN THE FOLLOWING SETS.

A = (X / X IS AN INTEGER, 2 .LE. X .LE. 11)

B = (Y / Y IS AN INTEGER, 1 .LE. Y .LE. 11)

WHERE .LE. MEANS LESS THAN OR EQUAL TO. LIST THE ELEMENTS IN THE RELATION,
3Y = 2X

NO. 11

GIVEN THE FOLLOWING SETS.

A = (X / X IS AN INTEGER, 8 .LE. X .LE. 12)

B = (Y / Y IS AN INTEGER, 4 .LE. Y .LE. 13)

WHERE .LE. MEANS LESS THAN OR EQUAL TO. GRAPH THE ELEMENTS IN THE RELATION,
2X = Y = 10

NO. 12

GIVEN THE FOLLOWING SETS.

A = (X / X IS AN INTEGER, 7 .LE. X .LE. 17)

B = (Y / Y IS AN INTEGER, 8 .LE. Y .LE. 17)

WHERE .LE. MEANS LESS THAN OR EQUAL TO, AND GIVEN THE FUNCTION, Y = X + 2 LIST THE ELEMENTS IN THE RANGE OF THE RELATION

NO. 13

GIVEN THE FOLLOWING SETS.

A = (PAMELA ALICE JANE KATE)

B = (STEVE ROBERT PAUL RICHARD THOMAS) .

CONSIDER THE SET PRODUCT AXB AND THE RELATION, 'BOTH NAMES HAVE THE SAME INITIAL' LIST THE ELEMENTS IN THE DOMAIN OF THE RELATION

NO. 14

CHARACTERIZE EACH OF THE FOLLOWING RELATIONS AS A FUNCTION OR NONFUNCTION AND EXPLAIN WHY.

1. 2X.P.2 + Y.P.2 = 0 WHERE X AND Y ARE INTEGERS AND X.P.2 MEANS X SQUARED.

2. X + 2Y = 3 WHERE X AND Y ARE INTEGERS.

3. Y.P.2 = 2X WHERE X AND Y ARE INTEGERS AND Y.P.2 MEANS Y SQUARED.

NO. 15

GIVEN THE FOLLOWING FUNCTION F(X) = AX/B + C WHERE A=1, B=2, AND C=3 WHERE X AND Y ARE INTEGERS. IF X IS EQUAL TO 3 COMPUTE THE CORRESPONDING F(X) VALUE.

NO. 16

CHARACTERIZE EACH OF THE FOLLOWING FUNCTIONS AS EITHER CONTINUOUS OR DISCONTINUOUS AND EXPLAIN WHY.

F(X) = X.P.3 - 2X.P.2 + 3 WHERE X IS A REAL NUMBER AND X.P.3 MEANS X CUBED.

Y = X.P.2 + 3 WHERE X IS ANY REAL NUMBER AND X.P.2 MEANS X SQUARED.

Y = 2X/(1 + X.P.2) WHERE X IS A REAL NUMBER AND X.P.2 MEANS X SQUARED.

NO. 17

SUPPOSE THAT A PAIR OF STANDARD DIE ARE TOSSED. LIST ALL ELEMENTS IN THE SAMPLE SPACE.

NO. 18

SUPPOSE THAT A WHITE DIE AND A BLACK DIE ARE TOSSED. COMPUTE THE NUMBER OF ELEMENTS IN THE SAMPLE SPACE.

NO. 19

SUPPOSE THAT TWO COINS ARE TOSSED. LIST ALL POSSIBLE OUTCOMES IN WHICH AT LEAST ONE COIN IS A TAIL

NO. 20

SUPPOSE THAT ONE CARD IS RANDOMLY SELECTED FROM THE FIVE HEART FACE CARDS (TEN JACK QUEEN AND ACE OF HEARTS) AND A SECOND CARD IS SELECTED FROM THE FIVE SPADE FACE CARDS. COMPUTE THE NUMBER OF OUTCOMES THAT CONTAIN AT LEAST ONE KING

NO. 21

SUPPOSE THAT 2 DICE ARE TOSSED ONE TIME. LIST ALL OUTCOMES IN WHICH THE SUM OF THE SPOTS IS 12

NO. 22

SUPPOSE THAT A COIN IS TOSSED 3 TIMES. COMPUTE THE NUMBER OF OUTCOMES THAT CONTAIN AT LEAST TWO HEADS

NO. 23

SUPPOSE THAT ONE CARD IS DEALT FROM THE FIVE FACE CARDS IN DIAMONDS (TEN JACK QUEEN KING AND ACE OF DIAMONDS). COMPUTE THE PROBABILITY THAT THE CARD IS A QUEEN OR BETTER.

NO. 24

SUPPOSE THAT A PAIR OF STANDARD DIE ARE TOSSED. COMPUTE THE PROBABILITY THAT THE NUMBER OF SPOTS IS LESS THAN 8

NO. 25

SUPPOSE THAT 3 DICE ARE TOSSED ONE TIME. COMPUTE THE PROBABILITY THAT THE NUMBER OF SPOTS TURNED UP IS EXACTLY 12

NO. 26

GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION.

16-18	1
13-15	7
10-12	18
07-09	16
04-06	7
01-03	1

A. COMPUTE THE MIDPOINT OF THE SECOND INTERVAL FROM THE TOP.

B. COMPUTE THE UPPER AND LOWER REAL LIMITS OF THE THIRD INTERVAL FROM THE BOTTOM.

C. IDENTIFY THE APPARENT LIMITS OF THE SECOND INTERVAL FROM THE TOP.

NO. 27

DRAW A FREQUENCY POLYGON FOR THE FOLLOWING DISTRIBUTION.

11-12	4
09-10	22
07-08	50
05-06	48
03-04	22
01-02	4

NO. 28

GROUP THE FOLLOWING DATA USING INTERVALS OF WIDTH 2 AND CONSTRUCT A FREQUENCY POLYGON.

5 4 5 5 7 7

3 4 6 4 7 7
7 6 7 7 8 1
1 7 4 6 6 5
8 5 2 2 1 2
7 2 5 6 5 5

NO. 29

DRAW A HISTOGRAM FOR THE FOLLOWING DISTRIBUTION.

16-17	2
14-15	9
12-13	23
10-11	32
08-09	23
06-07	9
04-05	2

NO. 30

GROUP THE FOLLOWING DATA USING INTERVALS OF WIDTH 2 AND CONSTRUCT A HISTOGRAM.

5 7 7 3 9 3
7 1 5 2 8 4
1 9 7 5 5 1
4 2 2 3 5 4
4 2 2 8 7 4
7 9 2 3 9 1

NO. 31

GRAPH THE CUMULATIVE FREQUENCY DISTRIBUTION FROM THE FOLLOWING DISTRIBUTION.

09-10	3
07-08	12
05-06	20
03-04	12
01-02	3

NO. 32

GROUP THE FOLLOWING DATA USING INTERVALS OF WIDTH 2 AND GRAPH THE CUMULATIVE FREQUENCY DISTRIBUTION.

5 6 5 6 3 7
7 6 4 6 5 3
6 2 8 3 5 9
8 5 1 8 2 1
1 7 9 5 5 4
6 6 2 9 3 7

NO. 33

A TRAY OF FRUIT CONTAINS 5 ORANGES, 7 APPLES AND 22 BANANAS. SUPPOSE THAT ONE PIECE OF FRUIT IS RANDOMLY SELECTED FROM THE TRAY. WHAT IS THE PROBABILITY THAT THE PIECE OF FRUIT IS AN ORANGE OR BANANA.

NO. 34

CONVERT THE FOLLOWING FREQUENCY DISTRIBUTION INTO A RELATIVE FREQUENCY DISTRIBUTION.

11-12	4
09-10	22
07-08	50
05-06	48
03-04	22
01-02	4

NO. 35

DRAW A HISTOGRAM FOR THE FOLLOWING RELATIVE FREQUENCY DISTRIBUTION.

14-16	.05
11-13	.25
08-10	.39
05-07	.25
02-04	.05

NO. 36

DRAW A FREQUENCY POLYGON FOR THE FOLLOWING RELATIVE FREQUENCY DISTRIBUTION.

20-22	.02
17-19	.09
14-16	.23
11-13	.30
08-10	.23
05-07	.09
02-04	.02

NO. 37

IT IS HYPOTHESIZED THAT A CERTAIN RAT HAS A .10 PROBABILITY OF TAKING THE LEFT HAND ALLEY, A .38 PROBABILITY OF TAKING THE CENTER ALLEY AND A .50 PROBABILITY OF TAKING THE RIGHT HAND ALLEY IN A MAZE. SUPPOSE THAT THE RAT IS GIVEN ONE TRIAL. COMPUTE THE PROBABILITY THAT THE RAT TAKES EITHER THE LEFT HAND OR THE CENTER ALLEY.

NO. 38

GIVEN THE FOLLOWING DENSITY FUNCTION F(X) = X/8 WHERE X IS RESTRICTED TO VALUES BETWEEN 0 AND 4, COMPUTE THE PROBABILITY DENSITY OF 1

NO. 39

GRAPH THE DENSITY FUNCTION F(X) = 2(4 + X)/9 WHERE X IS RESTRICTED TO VALUES BETWEEN -4 AND 1.

NO. 40

GIVEN THE FOLLOWING DENSITY FUNCTION F(X) = (X - 2)/8 WHERE X IS RESTRICTED TO VALUES BETWEEN 2 AND 6. IF ONE NUMBER IS SELECTED FROM THIS DISTRIBUTION COMPUTE THE PROBABILITY THAT THE NUMBER IS AT MOST 2.5

NO. 41

A THREE ITEM TEST WAS GIVEN TO 228 STUDENTS WITH THE FOLLOWING RESULTS. NOTE THAT THE DATA INCLUDES THE TOTAL NUMBER OF STUDENTS WHO PASSED THE ITEM OR COMBINATION OF ITEMS REGARDLESS OF WHAT OTHER ITEMS THEY MAY HAVE PASSED OR FAILED.

127 PASSED ITEM A

139 PASSED ITEM B

140 PASSED ITEM C

71 PASSED BOTH ITEMS A AND B

71 PASSED BOTH ITEMS A AND C

67 PASSED BOTH ITEMS B AND C

36 PASSED A AND C BUT FAILED B

IF ONE STUDENT IS RANDOMLY SELECTED FROM THIS POPULATION, COMPUTE THE PROBABILITY THAT THE STUDENT FAILED A AND C BUT PASSED B.

NO. 42

GIVEN THE FOLLOWING SETS WHERE U = A CUP B CUP C CUP D.

A = (SALLY KATE MARY SUSAN ANN)

B = (ALICE JANE PAMELA MARY SALLY)

C = (ANN SALLY ALICE JANE BETH)

D = (ALICE JANE PAMELA MARY SALLY)

IF ONE ELEMENT IS RANDOMLY SELECTED FROM U COMPUTE THE PROBABILITY THAT THE SAMPLED ELEMENT IS A MEMBER OF EITHER A OR B

NO. 43

GIVEN THE FOLLOWING SETS WHERE U = A CUP B CUP C.

A = (X/X IS AN INTEGER, 4 .LE. X .LE. 12)

B = (Y/Y IS AN INTEGER, 7 .LE.Y .LE. 19)

C = (Z/Z IS AN INTEGER, 24 .LE. Z .LE. 34)

IF ONE ELEMENT IS RANDOMLY SELECTED FROM U COMPUTE THE PROBABILITY THAT THE SAMPLED ELEMENT IS FROM BOTH A AND B

NO. 44

GIVEN THE FOLLOWING HYPOTHETICAL FREQUENCY DISTRIBUTION:

09-10	5
07-08	25
05-06	40
03-04	25
01-02	5

IF ONE NUMBER IS RANDOMLY SELECTED FROM THIS DISTRIBUTION, AND THE NUMBER IS BETWEEN 5 AND 10 COMPUTE THE PROBABILITY THAT THE NUMBER IS AT MOST 8

O. 45

IVEN THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION.

11-12	.03
09-10	.15
07-08	.30
05-06	.32
03-04	.15
01-02	.03

F ONE NUMBER IS RANDOMLY SELECTED FROM THIS DISTRIBUTION, AND THE UMBER IS AT MOST 6 COMPUTE THE PROBABILITY THAT THE NUMBER IS BETWEEN 1 AND 4

NO. 46

GIVEN THE FOLLOWING HYPOTHETICAL JOINT DISTRIBUTION.

09-10	0	2	4	2	0
07-08	2	14	23	14	2
05-06	4	23	40	23	4
03-04	2	14	23	14	2
01-02	0	2	4	2	0
	01-02	03-04	05-06	07-08	09-10

WHERE X IS THE VARIABLE ALONG THE ABSCISSA AND Y IS THE VARIABLE ALONG THE ORDINATE. IF ONE PAIR OF NUMBERS IS RANDOMLY SELECTED FROM THIS DISTRIBUTION AND X IS BETWEEN 1 AND 4 COMPUTE THE PROBABILITY THAT Y IS AT LEAST 5

NO. 47

GIVEN THE FOLLOWING HYPOTHETICAL JOINT DISTRIBUTION.

09-10	.00	.01	.02	.01	.00
07-08	.01	.06	.09	.06	.01
05-06	.02	.09	.18	.09	.02
03-04	.01	.06	.09	.06	.01
01-02	.00	.01	.02	.01	.00
	01-02	03-04	05-06	07-08	09-10

WHERE X IS THE VARIABLE ALONG THE ABSCISSA AND Y IS THE VARIABLE ALONG THE ORDINATE IF ONE PAIR OF NUMBERS (X,Y) IS RANDOMLY SELECTED FROM THIS DISTRIBUTION AND X IS LESS THAN 9 COMPUTE THE PROBABILITY THAT Y IS BETWEEN 5 AND 10

NO. 48

GIVEN THE FOLLOWING ORDERED PAIRS (X,Y).

(2,3)	(3,4)	(4,5)	(5,6)	(6,7)	(7,8)
(2,4)	(3,3)	(6,2)	(5,5)	(3,6)	(8,8)
(3,2)	(4,3)	(5,4)	(6,5)	(5,6)	(7,7)
(2,4)	(3,5)	(4,6)	(5,7)	(4,6)	(6,8)

IF ONE PAIR IS RANDOMLY SELECTED FROM THIS SAMPLE SPACE AND THE SAMPLED X VALUE IS GREATER THEN 4 COMPUTE THE PROBABILITY THAT THE SAMPLED Y VALUE IS LESS THAN 4

NO. 49

AN URN CONTAINS 33 WHITE MARBLES, 11 RED MARBLES AND 55 BLUE MARBLES. SUPPOSE THAT ONE MARBLE IS SELECTED FROM THE URN AND IT IS EITHER RED OR BLUE. COMPUTE THE PROBABILITY THAT THE MARBLE IS BLUE.

NO. 50

AN URN CONTAINS 18 PERCENT WHITE BALLS, 33 PERCENT RED BALLS AND 48 PERCENT GREEN BALLS. EACH BALL IS RETURNED TO THE URN BEFORE THE NEXT BALL IS DRAWN. SUPPOSE THAT ONE BALL IS RANDOMLY SELECTED FROM THE URN AND THE BALL IS NOT WHITE. COMPUTE THE PROBABILITY THAT THE BALL IS GREEN.

NO. 51

EXPERIENCE HAS SHOWN THAT ONLY 59 PERCENT OF THE STUDENTS WHO ARE ADMITTED TO A SPECIAL MATHEMATICS COURSE CAN ACTUALLY PASS THE COURSE. HOWEVER, RESEARCH HAS SHOWN THAT ONLY 33 PERCENT OF THE ADMITTED STUDENTS CAN PASS A PLACEMENT TEST BUT THAT OF THOSE STUDENTS WHO PASS THE COURSE 68 CAN PASS THE PLACEMENT TEST BEFOREHAND. ASSUMING THAT THE PLACEMENT TEST IS GOING TO BE USED FOR SCREENING STUDENTS, COMPUTE THE PROBABILITY THAT A STUDENT WILL PASS THE COURSE PROVIDED THAT HE HAS PASSED THE TEST.

NO. 52

GIVEN THE FOLLOWING HYPOTHETICAL JOINT DISTRIBUTION.

14-16	0	2	4	2	0

11-13	2	13	21	13	2
08-10	4	21	37	21	4
05-07	2	13	21	13	2
02-04	0	2	4	2	0
	02-04	05-07	08-10	11-13	14-16

WHERE X IS THE VARIABLE ALONG THE ABSCISSA AND Y IS THE VARIABLE ALONG THE ORDINATE STATE WHETHER OR NOT X AND Y ARE INDEPENDENT AND EXPLAIN WHY OR WHY NOT.

NO. 53

GIVEN THE FOLLOWING HYPOTHETICAL JOINT DISTRIBUTION.

09-10	.00	.01	.02	.01	.00
07-08	.01	.06	.09	.06	.01
05-06	.02	.09	.18	.09	.02
03-04	.01	.06	.09	.06	.01
01-02	.00	.01	.02	.01	.00
	01-02	03-04	05-06	07-08	09-10

WHERE X IS THE VARIABLE ALONG THE ABSCISSA AND Y IS THE VARIABLE ALONG THE ORDINATE STATE WHETHER OR NOT X AND Y ARE INDEPENDENT AND EXPLAIN WHY OR WHY NOT.

NO. 54

SUPPOSE THAT ONE CARD IS RANDOMLY SELECTED FROM THE FIVE HEART FACE CARDS (TEN JACK QUEEN AND ACE OF HEARTS) AND A SECOND CARD IS SELECTED FROM THE FIVE SPADE FACE CARDS. COMPUTE THE TOTAL NUMBER OF DISTINCT SEQUENCES THAT CAN BE GENERATED BY THIS PROCESS.

NO. 55

SUPPOSE THAT 2 COINS ARE TOSSED ONE TIME. COMPUTE THE TOTAL NUMBER OF DISTINCT SEQUENCES THAT CAN BE GENERATED BY THIS PROCESS.

NO. 56

A RANCHER IS ASKED TO RANK THE FOLLOWING BREEDS OF CATTLE IN ORDER OF PREFERENCE.

(HEREFORD ANGUS CHAROLAIS BRAHMAN)

COMPUTE THE TOTAL NUMBER OF RANK ORDERS THAT CAN BE GENERATED BY THIS PROCESS.

NO. 57

IN HOW MANY WAYS CAN THE FOLLOWING GROUP OF PEOPLE BE ARRANGED INTO JUST 2 SEATS.

(SUSAN PAMELA ALICE BETH KATE)

NO. 58

SUPPOSE THAT A 4 ITEM TEST IS TO BE CHOSEN FROM A 8 ITEM POOL.

COMPUTE THE TOTAL NUMBER OF TESTS THAT CAN BE FORMED.

NO. 59

SUPPOSE THAT A WHITE DIE AND A BLACK DIE ARE TOSSED. COMPUTE THAT PROBABILITY THAT EXACTLY ONE DIE TURNS UP THE 4 SPOT

NO. 60

SUPPOSE THAT A STANDARD DIE IS TOSSED 2 TIMES. COMPUTE THE PROBABILITY THAT THE FOUR SPOT TURNS UP EXACTLY TWICE

NO. 61

IT IS HYPOTHESIZED THAT A CERTAIN RAT HAS A .18 PROBABILITY OF TAKING THE LEFT HAND ALLEY, A .36 PROBABILITY OF TAKING THE CENTER ALLEY AND A .45 PROBABILITY OF TAKING THE RIGHT HAND ALLEY IN A MAZE. SUPPOSE THAT THE RAT IS GIVEN 3 TRIALS. COMPUTE THE PROBABILITY THAT HE CHOOSES THE CENTER ALLEY EXACTLY ONCE.

NO. 62

A PENCIL BOX CONTAINS 3 RED PENCILS, 4 BLACK PENCILS AND 7 BLUE PENCILS. SUPPOSE THAT 3 PENCILS ARE RANDOMLY SELECTED FROM THE BOX (WITH REPLACEMENT). COMPUTE THE PROBABILITY THAT EXACTLY TWO OF THE PENCILS SELECTED ARE BLUE.

NO. 63

GIVEN THE FOLLOWING HYPOTHETICAL FREQUENCY DISTRIBUTION.

09-10	5
07-08	25
05-06	40
03-04	25
01-02	5

SUPPOSE THAT 4 NUMBERS ARE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THIS DISTRIBUTION. COMPUTE THE PROBABILITY THAT EXACTLY TWO OF THE NUMBERS ARE GREATER THAN 6

NO. 64

GIVEN THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION.

09-10	.05
07-08	.25
05-06	.39
03-04	.25
01-02	.05

SUPPOSE THAT 3 NUMBERS ARE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THIS DISTRIBUTION. COMPUTE THE PROBABILITY THAT NONE OF THE NUMBERS IS EITHER A FIVE OR A SIX

NO. 65

AN URN CONTAINS 19 PERCENT WHITE BALLS, 15 PERCENT RED BALLS AND 65 PERCENT GREEN BALLS. EACH BALL IS RETURNED TO THE URN BEFORE THE NEXT BALL IS DRAWN. GRAPH THE THEORETICAL DISTRIBUTION OF WHITE BALLS IN THE 200 SAMPLES WHERE ONE SAMPLE CONSISTS OF SELECTING THREE BALLS FROM THE URN.

NO. 66

GRAPH THE DISTRIBUTION OF HEADS FOR 1000 TRIALS WHERE ONE TRIAL CONSISTS OF TOSSING THREE COINS.

NO. 67

A HAT CONTAINS 15 RED BALLS 31 BLACK BALLS AND 53 GREEN BALLS. GRAPH THE THEORETICAL DISTRIBUTION OF BLACK BALLS IN 2000 SAMPLES WHERE ONE SAMPLE CONSISTS OF RANDOMLY SELECTING (WITH REPLACEMENT) TWO BALLS

NO. 68

SUPPOSE THAT 2 DICE ARE TOSSED ONE TIME. FURTHER SUPPOSE THAT THIS PROCEDURE IS REPEATED FOR 500 TRIALS. GRAPH THE THEORETICAL DISTRIBUTION OF THE FIVE SPOT OVER THE 500 TRIALS.

NO. 69

SUPPOSE THAT ONE COIN IS TOSSED TWICE. COMPUTE THAT PROBABILITY THAT AT LEAST ONE OF THE COINS IS A TAIL.

NO. 70

SUPPOSE THAT 3 COINS ARE TOSSED ONE TIME. COMPUTE THE PROBABILITY THAT AT MOST TWO COINS TURN UP HEADS

NO. 71

A RANDOM VARIABLE CAN TAKE VALUES OF ZERO WITH PROBABILITY .28 , ONE WITH PROBABILITY .21 AND TWO WITH PROBABILITY .50 SUPPOSE THAT 3 OBSERVATIONS ARE MADE ON THE RANDOM VARIABLE. COMPUTE THE PROBABILITY THAT AT LEAST 2 OF THE VALUES OF THE RANDOM VARIABLES ARE ZEROS.

NO. 72

A TRAY OF FISH CONTAINS 5 COD, 7 HALIBUT AND 12 SALMON. SUPPOSE THAT 2 FISH ARE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THE TRAY. COMPUTE THE PROBABILITY THAT AT LEAST 1 OF THE FISH ARE COD.

NO. 73

GIVEN THE FOLLOWING HYPOTHETICAL FREQUENCY DISTRIBUTION.

09-10	5
07-08	25
05-06	40
03-04	25
01-02	5

SUPPOSE THAT 3 NUMBERS ARE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THIS DISTRIBUTION. COMPUTE THE PROBABILITY THAT AT LEAST 2 OF THE NUMBERS IS (ARE) BETWEEN 3 AND 6.

NO. 74

GIVEN THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION.

09-10	.05
07-08	.25
05-06	.39
03-04	.25
01-02	.05

SUPPOSE THAT 3 NUMBERS ARE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THIS DISTRIBUTION. COMPUTE THE PROBABILITY THAT AT LEAST 2 OF THE NUMBERS ARE GREATER THAN 4.

NO. 75

A VERY LARGE POPULATION CONTAINS 12 PERCENT COLLEGE STUDENTS 23 PERCENT HIGH SCHOOL GRADUATES AND 65 PERCENT INDIVIDUALS WITHOUT A HIGH SCHOOL DIPLOMA. SUPPOSE THAT 30 COLLEGE STUDENTS ARE RANDOMLY SELECTED FROM THIS POPULATION. COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION. 8 COLLEGE GRADUATES, 8 HIGH SCHOOL GRADUATES AND 12 INDIVIDUALS WITHOUT A HIGH SCHOOL DIPLOMA.

NO. 76

A PENCIL BOX CONTAINS 4 RED PENCILS, 4 BLACK PENCILS AND 6 BLUE PENCILS. SUPPOSE THAT 20 PENCILS ARE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THIS DISTRIBUTION. COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION. 7 RED, 7 BLACK AND 6 BLUE PENCILS.

NO. 77

GIVEN THE FOLLOWING PROBABILITY DISTRIBUTION.

05-06	.25
03-04	.50
01-02	.25

IF 20 NUMBERS ARE RANDOMLY SAMPLED (WITH REPLACEMENT) FROM THE ABOVE DISTRIBUTION, COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION.

05-06	5
03-04	10
01-02	5

NO. 78

GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION,

05-06	25
03-04	50
01-02	25

IF 15 NUMBERS ARE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THE ABOVE DISTRIBUTION, COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION.

05-06	4
03-04	7
01-02	4

NO. 79

AN URN CONTAINS 39 PERCENT WHITE BALLS, 16 PERCENT RED BALLS AND 44 PERCENT GREEN BALLS. SUPPOSE THAT 10 BALLS ARE RANDOMLY SELECTED FROM THE URN. COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION 2 WHITE BALLS 3 RED BALLS AND 4 GREEN BALLS.

NO. 80

A HAT CONTAINS 13 RED BALLS 19 BLACK BALLS AND 67 GREEN BALLS. SUPPOSE THAT 20 BALLS ARE RANDOMLY SELECTED (WITHOUT REPLACEMENT) FROM THIS DISTRIBUTION. COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION. 7 RED, 9 BLACK AND 4 GREEN BALLS.

NO. 81

GIVEN THE FOLLOWING PROBABILITY DISTRIBUTION,

05-06	.25
03-04	.50
01-02	.25

IF 10 NUMBERS ARE RANDOMLY SAMPLED (WITHOUT REPLACEMENT) FROM THE ABOVE DISTRIBUTION, COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION.

05-06	2
03-04	6
01-02	2

```
NO. 82

GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION.

          05-06        31
          03-04        63
          01-02        31

IF 12 NUMBERS ARE RANDOMLY SELECTED(WITHOUT REPLACEMENT) FROM THE ABOVE
DISTRIBUTION, COMPUTE THE PROBABILITY OF OBTAINING THE FOLLOWING DISTRIBUTION.


          05-06        3
          03-04        6
          01-02        3


NO. 83

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

            6 2 8 2 7 8 7 6
            4 6 7 1 6 6 9 2
            6 4 4 8 6 4 4 3
            4 6 2 4 3 8 6 2
            8 6 2 3 8 2 5 8

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES
THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) OF THE ABOVE TABLE. COMPUTE
SUM X(I,4) WHERE I RUNS FROM 1 TO 2


NO. 84

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

            2 7 8 9 2 6 1 8
            1 6 3 9 4 5 2 6
            1 2 3 9 5 6 6 5
            6 2 2 7 3 3 5 3
            3 7 2 6 1 3 5 4

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES
THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) OF THE ABOVE TABLE. COMPUTE
SUM X(I,3)X(I,5) WHERE I RUNS FROM 1 TO 2


NO. 85

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.
```

4	4	3	5	3	3	8	2
3	4	9	4	6	5	3	9
5	4	8	2	5	7	8	4
8	7	3	2	9	4	7	9
2	8	7	2	2	7	9	6

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) OF THE ABOVE TABLE. COMPUTE SUM X(I,J)X(2,1) HERE I RUNS FROM 1 TO 3 AND J RUNS FROM 1 TO 6 AND I IS ALWAYS LESS THAN J

NO. 86

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

9	4	1	5	6	5	1	6
7	7	6	8	4	9	9	7
6	7	6	2	7	7	7	7
6	6	9	2	9	9	2	5
2	4	6	7	5	2	3	1

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) OF THE ABOVE TABLE. COMPUTE SUM X(I,1)X(I,2) WHERE I RUNS FROM 1 TO 3

NO. 87

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

4	2	5	2	2	7	7	8
6	2	3	2	7	4	5	4
5	4	6	3	9	8	8	9
3	4	3	4	6	5	3	3
7	3	6	6	2	5	4	5

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) OF THE ABOVE TABLE. COMPUTE SUM (SUM OVER I X(I,J).P.2 WHERE I RUNS FROM 1 TO 2) AND J RUNS FROM 1 TO 7

NO. 88

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

4	7	4	2	1	6	2	8
5	3	5	6	6	6	2	3
2	3	6	6	5	9	1	4
3	5	2	2	7	6	6	9
7	8	4	7	3	4	2	9

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) OF THE ABOVE TABLE. COMPUTE SUM X(I,1)X(I,J) WHERE I RUNS FROM 1 TO 3 AND J RUNS FROM 1 TO 5

NO. 89

GIVEN THE FOLLOWING 3 BLOCKS OF 1-DIGIT NUMBERS

```
3 8 5 1 6 6 8 5 5 6 6 5 7 3 7
9 7 7 1 6 2 4 3 6 2 7 2 7 1 2
5 8 5 8 4 7 7 9 6 8 6 6 1 2 4
6 6 6 8 8 7 6 2 3 1 5 2 6 2 5
2 9 2 8 5 3 2 8 2 1 8 2 7 6 7

5 8 4 2 9 3 3 7 4 7 8 2 8 7 3
8 4 7 4 7 3 4 1 6 6 3 4 7 5 5
4 2 2 7 5 3 7 4 5 7 3 6 3 3 1
2 7 9 2 1 7 8 1 9 3 1 6 5 9 5
4 3 6 6 6 6 2 4 8 2 2 5 1 4 8

6 5 9 7 7 4 2 8 8 3 3 3 9 6 9
6 2 3 7 4 1 6 5 5 2 5 8 9 3 3
2 4 8 7 8 5 7 6 3 5 7 1 7 2 3
2 1 5 8 8 8 7 7 9 9 8 6 7 1 7
6 9 6 3 7 6 2 9 8 1 9 5 4 6 2
```

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) AND K DESIGNATES THE BLOCKS (K = 1 FOR THE TOP BLOCK). COMPUTE SUM X(I,J,2) WHERE I RUNS FROM 1 TO 3 AND J RUNS FROM 1 TO 3

NO. 90

GIVEN THE FOLLOWING 3 BLOCKS OF 1-DIGIT NUMBERS

```
7 3 9 2 8 5 6 7 8 3 9 7 6 6 9
6 3 6 9 3 6 6 5 4 1 9 4 7 7 6
3 2 7 4 6 3 3 2 6 2 9 8 6 3 7
6 4 5 3 3 8 4 6 5 2 7 3 9 9 1
6 4 8 7 8 4 7 4 2 1 2 6 9 6 5

5 3 4 5 8 4 5 3 7 8 7 2 1 3 3
8 9 9 1 6 2 7 3 5 2 3 2 5 2 7
3 9 5 4 8 7 8 7 7 5 2 6 7 9 3
7 2 9 8 7 4 7 5 2 8 4 4 3 5 3
2 3 5 2 7 9 8 4 7 5 2 1 5 9 4

2 8 2 2 2 4 8 5 1 5 6 7 5 4 2
6 8 2 6 7 7 2 4 8 2 5 2 4 2 5
```

5 7 3 9 9 4 3 7 7 2 9 1 5 8 7
7 6 5 9 5 9 7 1 8 4 4 6 2 2 3
6 7 6 6 2 6 3 2 7 2 5 9 4 5 6

WHERE I DESIGNATES THE ROWS (I = 1 FOR THE TOP ROW) AND J DESIGNATES THE COLUMNS (J = 1 FOR THE LEFT MOST COLUMN) AND K DESIGNATES THE BLOCKS (K = 1 FOR THE TOP BLOCK). COMPUTE SUM X(I,J,K) WHERE I RUNS FROM 1 TO 3 AND J RUNS FROM 1 TO 4 AND K RUNS FROM 1 TO 3

NO. 91

GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION.

15-17	3
12-14	12
09-11	20
06-08	12
03-05	3

COMPUTE THE MEAN AND STANDARD DEVIATION OF THE ABOVE DISTRIBUTION.

NO. 92

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

4 7 5 2 6 1 9 8
4 2 7 1 7 1 7 6
5 7 3 6 5 6 5 2
6 3 7 8 3 4 7 4
7 5 5 4 5 2 6 7

COMPUTE THE MEAN AND STANDARD DEVIATION OF THE ABOVE NUMBERS:

NO. 93

GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION.

09-10	3
07-08	12
05-06	20
03-04	12
01-02	3

COMPUTE THE MEDIAN AND SEMI-INTERQUARTILE RANGE OF THE ABOVE DISTRIBUTION.

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

4 7 5 6 6 6 6 7
4 1 7 3 4 5 6 3
5 5 3 7 5 7 7 6
3 6 8 6 4 3 4 6
6 2 8 9 4 5 9 4

COMPUTE THE MEDIAN AND SEMI-INTERQUARTILE RANGE OF THE ABOVE NUMBERS.

NO. 95

STATE WHETHER THE MEAN OR THE MEDIAN SHOULD BE USED TO DESCRIBE THE DISTRIBUTIONS LISTED BELOW AND GIVE THE REASON FOR YOUR ANSWER.

A. DISTRIBUTION OF INCOME IN THE UNITED STATES.

B. DISTRIBUTION OF HEIGHT FOR COLLEGE MALES

C. SCORES ON A WELL CONSTRUCTED ACHIEVEMENT TEST.

NO. 96

GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION.

19-21	1
16-18	7
13-15	17
10-12	25
07-09	17
04-06	7
01-03	1

COMPUTE THE 22 PERCENTILE POINT OF THE DISTRIBUTION.

NO. 97

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

4 8 6 6 8 7 4 2
3 8 4 8 5 8 9 9
5 7 8 8 4 7 1 7
2 7 7 2 5 5 8 9
8 6 4 9 8 6 2 6

COMPUTE THE 87 PERCENTILE POINT OF THE DISTRIBUTION.

NO. 98

GIVEN THE FOLLOWING FREQUENCY DISTRIBUTION.

15-17	3
12-14	12
09-11	20
06-08	12
03-05	3

COMPUTE THE PERCENTILE RANK CORRESPONDING TO THE SCORE OF 7

NO. 99

GIVEN THE FOLLOWING TABLE OF 1-DIGIT NUMBERS.

2	4	8	4	8	9	5	2
6	4	3	8	8	1	1	8
6	8	5	8	5	2	5	2
6	6	7	3	7	9	5	5
2	4	7	4	2	9	9	1

COMPUTE THE PERCENTILE RANK CORRESPONDING TO THE SCORE OF 5

NO. 100

A RAT PRESSES A BAR AN AVERAGE OF 18 TIMES PER MINUTE WHEN A LIGHT IS ON AND 7 TIMES PER MINUTE WHEN THE LIGHT IS OFF. UNDER BOTH CONDITIONS THE DISTRIBUTION OF BAR PRESSES IS NORMAL WITH A STANDARD DEVIATION OF 6 PRESSES PER MINUTE. DURING A CERTAIN ONE MINUTE TRIAL WITH THE LIGHT ON THE RAT PRESSED THE BAR 14 TIMES. WHAT IS THE STANDARD SCORE EQUIVALENT FOR THIS TRIAL.

NO. 101

SUPPOSE THAT A COIN IS TOSSED 51 TIMES. COMPUTE THE STANDARD SCORE EQUIVALENT OF 27 HEADS.

NO. 102

GIVEN THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION.

26-29	.02
22-25	.09
18-21	.23
14-17	.30
10-13	.23
06-09	.09
02-05	.02

COMPUTE THE EXPECTED VALUE OF X SQUARED

NO. 103

GIVEN THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION,

20-22	.02
17-19	.09
14-16	.23
11-13	.30
08-10	.23
05-07	.09
02-04	.02

COMPUTE THE EXPECTED VALUE OF (X - E(X)) SQUARED.

NO. 104

GIVEN THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION FOR THE VARIABLE X

17-19	.03
14-16	.15
11-13	.30
08-10	.32
05-07	.15
02-04	.03

AND THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION FOR THE VARIABLE Y

15-16	.01
13-14	.06
11-12	.16
09-10	.25
07-08	.26
05-06	.16
03-04	.06
01-02	.01

COMPUTE THE EXPECTED VALUE OF Z WHERE Z = 3X - Y + 5

NO. 105

GIVEN THE PROBABILITY DENSITY FUNCTION F(X) = 2X/25 WHERE X IS RESTRICTED TO VALUES BETWEEN 0 AND 5. COMPUTE THE MEAN AND VARIANCE OF X.

NO. 106

SUPPOSE THAT THE SAMPLE MEDIAN IS BEING USED TO ESTIMATE THE MEDIAN OF THE ENTIRE POPULATION. IS THIS ESTIMATOR

A. CONSISTENT

B. SUFFICIENT

C. UNBIASED

D. EFFICIENT

NO. 107

GIVEN THE FOLLOWING HYPOTHETICAL FREQUENCY DISTRIBUTION.

07-08	4
05-06	13
03-04.	14
01-02	4

SUPPOSE THAT SUCCESSIVE SAMPLES OF SIZE 34 ARE RANDOMLY DRAWN (WITH REPLACEMENT) FROM THIS DISTRIBUTION. WHAT WOULD BE THE STANDARD ERROR OF THE SAMPLE MEANS.

NO. 108

GIVEN THE FOLLOWING HYPOTHETICAL PROBABILITY DISTRIBUTION.

09-10	.05
07-08	.25
05-06	.39
03-04	.25
01-02	.05

SUPPOSE THAT SUCCESSIVE SAMPLES OF SIZE 46 ARE TO BE RANDOMLY SELECTED (WITH REPLACEMENT) FROM THIS DISTRIBUTION. COMPUTE THE STANDARD ERROR OF THE SAMPLE MEANS FOR SAMPLES OF THIS SIZE.

NO. 109

THE LIFETIMES OF STANDARD FLUORESCENT LIGHT BULBS PRODUCED BY A CERTAIN COMPANY HAVE A STANDARD DEVIATION OF 100 HOURS. SUPPOSE THAT 400 BULBS WERE SELECTED FOR TESTING AND THEIR AVERAGE LIFETIME WAS FOUND TO BE 800 HOURS. COMPUTE THE STANDARD ERROR OF THE SAMPLE MEANS FOR SAMPLES OF THIS SIZE.

NO. 110

SUPPOSE THAT ONE IS SAMPLING (WITH REPLACEMENT) FROM THE FOLLOWING HYPOTHETICAL FREQUENCY DISTRIBUTION.

07-08	6
05-06	21
03-04	22
01-02	6

WHAT SAMPLE SIZE WOULD BE NECESSARY TO INSURE THAT THE SAMPLE MEAN HAS A 90 PERCENT CHANCE OF BEING WITHIN ONE TENTH OF ONE STANDARD DEVIATION FROM THE MEAN OF THE HYPOTHETICAL DISTRIBUTION.

NO. 111

SUPPOSE THAT ONE IS SAMPLING (WITH REPLACEMENT) FROM THE FOLLOWING HYPOTHETICAL PROBABILLITY DISTRIBUTION

09-10	.05
07-08	.25
05-06	.39
03-04	.25
01-02	.05

WHAT SAMPLE SIZE WOULD BE NECESSARY TO INSURE THAT THE SAMPLE MEAN HAS A 95 PERCENT CHANCE OF BEING WITHIN ONE FIFTH OF ONE STANDARD DEVIATION FROM THE MEAN OF THE HYPOTHETICAL DISTRIBUTION.

NO. 112

GIVEN THE FOLLOWING SAMPLE FROM A HYPOTHETICAL FREQUENCY DISTRIBUTION

07-08	4
05-06	16
03-04	16
01-02	4

AND A SECOND SAMPLE FROM THE SAME DISTRIBUTION

07-08	3
05-06	12

03-04	12
01-02	3

ESTIMATE THE STANDARD ERROR OF THE MEAN FOR SAMPLES OF SIZE 74 RANDOMLY SELECTED (WITH REPLACEMENT) FROM THE HYPOTHETICAL DISTRIBUTION.

NO. 113

GIVEN THE FOLLOWING SAMPLE FROM A HYPOTHETICAL PROBABILITY DISTRIBUTION

09-10	.05
07-08	.25
05-06	.39
03-04	.25
01-02	.05

AND A SECOND SAMPLE FROM THE SAME DISTRIBUTION

09-10	.05
07-08	.25
05-06	.39
03-04	.25
01-02	.05

ESTIMATE THE STANDARD ERROR OF THE MEAN FOR SAMPLES OF SIZE 53 RANDOMLY SELECTED (WITH REPLACEMENT) FROM THE HYPOTHETICAL DISTRIBUTION.

NO. 114

GIVEN A NORMAL DISTRIBUTION WITH MEAN 51 AND VARIANCE 45 COMPUTE THE PROBABILITY DENSITY OF 60

NO. 115

FRESHMEN AT BROWNING UNIVERSITY HAVE A MEAN SCHOLASTIC APTITUDE TEST SCORE OF 1200 AND A STANDARD DEVIATION OF 200. IF A SAMPLE OF SCHOLATIC APTITUDE TEST SCORES WERE EXAMINED FOR BROWNING FRESHMEN, WHAT PROPORTION OF THE CASES WOULD BE EXPECTED TO HAVE SCORES BETWEEN 900 AND 1000.

NO. 116

GIVEN A NORMAL DISTRIBUTION WITH MEAN 75 AND VARIANCE 7 IF ONE NUMBER IS RANDOMLY SELECTED FROM THIS DISTRIBUTION, WHAT IS THE PROBABILITY THAT THE NUMBER IS AT MOST 53

NO. 117

MALE STUDENTS AT GREEN COLLEGE HAVE AN AVERAGE HEIGHT OF 71 INCHES WITH A WITH A STANDARD DEVIATION OF 5 INCHES. ASSUMING THAT HEIGHT IS NORMALLY DISTRIBUTED, WHAT IS THE PROBABILITY THAT THE AVERAGE HEIGHT OF 100 MALE STUDENTS SELECTED FROM THIS POPULATION IS AT MOST 73 INCHES

NO. 118

X IS A NORMALLY DISTRIBUTED RANDOM VARIABLE WITH MEAN 23 AND VARIANCE 80 IF TWO OBSERVATIONS X1 AND X2 ARE RANDOMLY SELECTED FROM THIS DISTRIBUTION, WHAT IS THE PROBABILITY THAT Y IS AT MOST 94 WHERE Y = 3X1 + 2X2

NO. 119

X IS A NORMALLY DISTRIBUTED RANDOM VARIABLE WITH MEAN 70 AND VARIANCE 43 AND Y IS ALSO NORMALLY DISTRIBUTED WITH MEAN 114 AND VARIANCE 42 WHAT IS THE PROBABILITY THAT Z IS AT LEAST 167 WHERE Z = X + Y

NO. 120

WHICH OF THE FOLLOWING DISTRIBUTIONS ARE APPROXIMATELY NORMAL.

A. DISTRIBUTION OF REACTION TIMES.

B. DISTRIBUTION OF AUTOMOBILE ACCIDENTS OVER A ONE YEAR PERIOD.

C. SCORES ON THE WECHSLER ADULT INTELLIGENCE SCALE.

NO. 121

A STUDENT TAKES A 100 ITEM FOUR-ALTERNATIVE MULTIPLE CHOICE TEST AND GUESSES ON EVERY ITEM. WHAT IS THE PROBABILITY THAT HIS SCORE IS AT MOST 30.

NO. 122

SUPPOSE THAT 100 DICE ARE THROWN, COMPUTE THE PROBABILITY THAT THE TWO SPOT TURNS UP BETWEEN 10 AND 15 TIMES.

NO. 123

IT IS HYPOTHESIZED THAT A CERTAIN RAT HAS A .20 PROBABILITY OF TAKING THE LEFT HAND ALLEY, A .14 PROBABILITY OF TAKING THE CENTER ALLEY AND A .65 PROBABILITY OF TAKING THE RIGHT HAND ALLEY IN A MAZE. SUPPOSE THAT THE RAT IS GIVEN 110 TRIALS. WHAT IS THE PROBABILITY THAT THE RAT TAKES THE CENTER ALLEY AT MOST 17 TIMES.

NO. 124

AN URN CONTAINS 28 WHITE MARBLES, 34 RED MARBLES AND 38 BLUE MARBLES. SUPPOSE THAT 103 MARBLES ARE SELECTED (WITH REPLACEMENT) FROM THIS DISTRIBUTION. WHAT IS THE PROBABILITY THAT AT MOST 22 RED MARBLES ARE SELECTED

NO. 125

THIS IS A DUMMY FORM = 125

NO. 126

THE SCORES OF COLLEGE SENIORS ON A SCHOLASTIC APTITUDE TEST ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 50 POINTS. IF THE AVERAGE TEST SCORE OF 100 SENIORS SELECTED FROM THIS DISTRIBUTION IS 150, TEST THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS 150 POINTS SETTING ALPHA AT THE .10 LEVEL.

NO. 127

LOG REACTION TIME TO AN AUDITORY STIMULUS IS NORMALLY DISTRIBUTED FOR COLLEGE SOPHOMORES WHITH A STANDARD DEVIATION OF 2.5 LOG MILLISECONDS. IF 36 COLLEGE SOPHOMORES ARE GIVEN THE REACTION TIME TEST AND THEIR AVERAGE REACTION TIME WAS 5 LOG MILLISECONDS, TEST THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS GREATER THAN 5 LOG MILLISECONDS SETTING ALPHA AT THE .01 LEVEL.

NO. 128

THE SCORES OF EMPLOYED MACHINISTS ON A TEST OF MECHANICAL COMPREHENSION ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 20 POINTS. SUPPOSE THAT 225 MACHINISTS ARE RANDOMLY SELECTED FOR TESTING AND THEIR AVERAGE SCORE ON THE TEST WAS 105. COMPUTE THE PROBABILITY OF A TYPE 1 ERROR ASSOCIATED WITH REJECTING THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS 104 POINTS

NO. 129

THE RUNNING TIMES OF ADULT NORWAY RATS IN AN IPSWICH MAZE ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 10 SECONDS. SUPPOSE THAT 25 NORWAY RATS ARE RUN IN THIS MAZE AND THEIR AVERAGE RUNNING TIME WAS 50 SECONDS. COMPUTE THE PROBABILITY OF A TYPE 1 ERROR ASSOCIATED WITH REJECTING THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS AT LEAST 49 SECONDS

NO. 130

LOG REACTION TIME TO AN AUDITORY STIMULUS IS NORMALLY DISTRIBUTED FOR COLLEGE SOPHOMORES WHITH A STANDARD DEVIATION OF 2.5 LOG MILLISECONDS. IF 36 COLLEGE SOPHOMORES ARE GIVEN THE REACTION TIME TEST AND THEIR AVERAGE REACTION TIME WAS 5 LOG MILLISECONDS, COMPUTE THE 90 PERCENT CONFIDENCE INTERVAL FOR THE MEAN OF THE ENTIRE POPULATION.

NO. 131

THE SCORES OF COLLEGE SENIORS ON A SCHOLASTIC APTITUDE TEST ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 50 POINTS. IF THE AVERAGE TEST SCORE OF 100 SENIORS SELECTED FROM THIS DISTRIBUTION IS 150, TEST THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS 148 POINTS SETTING ALPHA AT THE .02 LEVEL. COMPUTE THE POWER OF THE TEST TO REJECT THE NULL HYPOTHESIS IF THE TRUE MEAN OF THE POPULATION IS 137 POINTS

NO. 132

LOG REACTION TIME TO AN AUDITORY STIMULUS IS NORMALLY DISTRIBUTED FOR COLLEGE SOPHOMORES WHITH A STANDARD DEVIATION OF 2.5 LOG MILLISECONDS. IF 36 COLLEGE SOPHOMORES ARE GIVEN THE REACTION TIME TEST AND THEIR AVERAGE REACTION TIME WAS 5 LOG MILLISECONDS, TEST THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS 5 LOG MILLISECONDS SETTING ALPHA AT THE .05 LEVEL. PLOT THE OPERATING CHARACTERISTIC CURVE FOR THIS TEST.

NO. 133

THE SCORES OF EMPLOYED MACHINISTS ON A TEST OF MECHANICAL COMPREHENSION ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 20 POINTS. SUPPOSE THAT 225 MACHINISTS ARE RANDOMLY SELECTED FOR TESTING AND THEIR AVERAGE SCORE ON THE TEST WAS 105. TEST THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS 101 POINTS SETTING ALPHA AT THE .01 LEVEL. COMPUTE THE PROBABILITY OF A TYPE 2 ERROR ASSOCIATED WITH ACCEPTING THE STATED HYPOTHESIS IF THE TRUE MEAN OF THE POPULATION IS 106 POINTS

NO. 134

LOG REACTION TIME TO AN AUDITORY STIMULUS IS NORMALLY DISTRIBUTED FOR COLLEGE SOPHOMORES WHITH A STANDARD DEVIATION OF 2.5 LOG MILLISECONDS. SUPPOSE THAT A SAMPLE OF 36 COLLEGE SOPOMORES WERE DEPRIVED OF SLEEP FOR 48 HOURS AND THEIR AVERAGE REACTION TIME WAS 10 LOG MILLISECONDS. THEN A CONTROL GROUP OF 49 SOPHOMORES WERE TESTED AND THEIR AVERAGE REACTION TIME WAS 4 LOG MILLISECONDS. TEST THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO SETTING ALPHA AT THE .02 LEVEL.

NO. 135

A WORLD HEALTH ORGANIZATION MADE A SURVEY IN BRAZIL AND FOUND THAT THE WEIGHT OF ADULT MALES WAS NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 10 POUNDS. SUPPOSE THAT A SAMPLE OF 400 RURAL MALES SHOWED AN AVERAGE WEIGHT OF 158 POUNDS AND A SAMPLE OF 169 URBAN MALES HAD AN AVERAGE WEIGHT OF 153 POUNDS. COMPUTE THE PROBABILITY OF A TYPE 1 ERROR ASSOCIATED WITH REJECTING THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO.

NO. 136

LOG REACTION TIME TO AN AUDITORY STIMULUS IS NORMALLY DISTRIBUTED FOR COLLEGE SOPHOMORES WHITH A STANDARD DEVIATION OF 2.5 LOG MILLISECONDS. SUPPOSE THAT A SAMPLE OF 36 COLLEGE SOPOMORES WERE DEPRIVED OF SLEEP FOR 48 HOURS AND THEIR AVERAGE REACTION TIME WAS 11 LOG MILLISECONDS. THEN A CONTROL GROUP OF 49 SOPHOMORES WERE TESTED AND THEIR AVERAGE REACTION TIME WAS 3 LOG MILLISECONDS. COMPUTE THE 98 PERCENT CONFIDENCE INTERVAL FOR THE DIFFERENCE BETWEEN THE POPULATION MEANS.

NO. 137

THE LIFETIMES OF STANDARD FLUORESCENT LIGHT BULBS PRODUCED BY A CERTAIN COMPANY AVERAGE 800 HOURS WITH A STANDARD DEVIATION OF 100 HOURS. SUPPOSE THAT A SAMPLE OF 400 BULBS WAS SELECTED FROM THE MORING PRODUCTION AND THE AVERAGE LIFETIME FOR THE SAMPLE WAS 809 HOURS. A SECOND SAMPLE OF 500 CASES, THIS TIME FROM THE AFTERNOON PRODUCTION, WAS ALSO TAKEN AND THE AVERAGE LIFETIME FOR THE AFTERNOON SAMPLE WAS 777 HOURS. TEST THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO SETTING ALPHA AT THE .01 LEVEL. COMPUTE THE POWER OF THE TEST TO REJECT THE NULL HYPOTHESIS WHEN THE TRUE MEAN DIFFERENCE IS 3

NO. 138

THE SCORES OF COLLEGE SENIORS ON A SCHOLASTIC APTITUDE TEST ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 50 POINTS. SUPPOSE THAT TWO MATCHED SAMPLES OF 144 CASES EACH ARE GIVEN THE TEST. THE FIRST SAMPLE WAS GIVEN PRACTICE ON TAKING SIMILAR TESTS AND THE SECOND CONTROL SAMPLE WAS GIVEN NO PRACTICE. THE AVERAGE SCORE OF THE FIRST SAMPLE WAS 141

POINTS AND THE AVERAGE SCORE OF THE SECOND SAMPLE WAS 163 POINTS. IF THE CORRELATION BETWEEN THE TWE SAMPLES WAS .40 TEST THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO SETTING ALPHA AT THE .05 LEVEL.

NO. 139

LOG REACTION TIME TO AN AUDITORY STIMULUS IS NORMALLY DISTRIBUTED FOR COLLEGE SOPHOMORES WHITH A STANDARD DEVIATION OF 2.5 LOG MILLISECONDS. SUPPOSE THAT A SAMPLE OF 36 COLLEGE SOPOMORES WERE DEPRIVED OF SLEEP FOR 48 HOURS AND THEIR AVERAGE REACTION TIME WAS 9 LOG MILLISECONDS. THEN A MATCHED CONTROL SAMPLE OF 36 SOPHOMORES WAS TESTED AND THEIR AVERAGE REACTION TIME WAS 6 LOG MILLISECONDS. IF THE CORRELATION BETWEEN THE TWO SAMPLES WAS .50 COMPUTE THE PROBABILITY OF A TYPE 1 ERROR ASSOCIATED WITH REJECTING THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO.

NO. 140

THE RUNNING TIMES OF ADULT NORWAY RATS IN AN IPSWICH MAZE ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 10 SECONDS. SUPPOSE THAT 25 CONTROL RATS WERE RUN IN THIS MAZE AND THEIR AVERAGE RUNNING TIME WAS 46 SECONDS. SUPPOSE FURTHER THAT A MATCHED SAMPLE OF RATS INJECTED WITH A DRUG WAS ALSO RUN IN THE MAZE AND THEIR AVERAGE RUNNING TIME WAS 46 SECONDS. IF THE CORRELATION BETWEEN THE TWO SAMPLES IS .30 COMPUTE THE 80 PERCENT CONFIDENCE INTERVAL FOR THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS.

NO. 141

THE SCORES OF COLLEGE SENIORS ON A SCHOLASTIC APTITUDE TEST ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 50 POINTS. SUPPOSE THAT TWO MATCHED SAMPLES OF 144 CASES EACH ARE GIVEN THE TEST. THE FIRST SAMPLE WAS GIVEN PRACTICE ON TAKING SIMILAR TESTS AND THE SECOND CONTROL SAMPLE WAS GIVEN NO PRACTICE. THE AVERAGE SCORE OF THE FIRST SAMPLE WAS 153 POINTS AND THE AVERAGE SCORE OF THE SECOND SAMPLE WAS 140 POINTS. IF THE CORRELATION BETWEEN THE TWE SAMPLES WAS .40 TEST THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO SETTING ALPHA AT THE .10 LEVEL. COMPUTE THE POWER OF THE TEST TO REJECT THE NULL HYPOTHESIS WHEN THE TRUE MEAN DIFFERENCE IS 9

NO. 142

THE SCORES OF EMPLOYED MACHINISTS ON A TEST OF MECHANICAL COMPREHENSION ARE NORMALLY DISTRIBUTED WITH A STANDARD DEVIATION OF 20 POINTS. SUPPOSE THAT A SAMPLE OF 225 MACHINISTS WORKING ON LATHES WERE COMPARED WITH A SAMPLE OF 100 MACHINISTS WORKING ON MILLING MACHINES . THE MACHINISTS WORKING ON LATHES SHOWED AN AVERAGE TEST SCORE OF 113 POINTS AND THE MACHINISTS WORKING ON MILLING MACHINES SHOWED AN AVERAGE TEST SCORE OF 105 POINTS. COMPUTE THE SAMPLE SIZE THAT WOULD BE NECESSARY TO REJECT

THE NULL HYPOTHESIS WITH A POWER OF .75 IF THE TRUE DIFFERENCE BEWTEEN THE POPULATION MEANS IS 4

NO. 143

THE MEAN HIGHSCHOOL GRADE POINT AVERAGE FOR A SAMPLE OF 82 APPLICANTS TO A LARGE UNIVERSITY WAS 3.2 AND THE STANDARD DEVIATION COMPUTED ON THIS SAMPLE WAS .9. TEST THE HYPOTHESIS THAT THE MEAN OF THE ENTIRE POPULATION IS 3 SETTING ALPHA AT THE .01 LEVEL.

NO. 144

SUPPOSE THAT 26 ADULTS ARE ADMINISTERED THE WECHSLER ADULT INTELLIGENCE SCALE AND THEIR AVERAGE TEST SCORE WAS 105 AND THE STANDARD DEVIATION OF THESE SCORES WAS 15. TEST THE HYPOTHSIS THAT THE MEAN OF THE ENTIRE POPULATION IS LESS THAN 100 POINTS SETTING ALPHA AT THE .10 LEVEL.

NO. 145

SUPPOSE THAT THE AVERAGE TEST SCORE OF A SAMPLE OF 101 HIGHSCHOOL STUDENTS ON A TEST OF VERBAL COMPREHENSION IS 50 AND THE STANDARD DEVIATION COMPUTED ON THIS SAMPLE IS 10. COMPUTE THE 98 PERCENT CONFIDENCE INTERVAL FOR THE MEAN OF THE ENTIRE POPULATION.

NO. 146

SUPPOSE THAT A SAMPLE OF 25 CLERK TYPISTS ARE GIVEN THE BERNARD CLERICAL APTITUDE TEST. THE AVERAGE SCORE FOR THIS GROUP WAS 46 AND THE STANDARD DEVIATION FOR THIS SAMPLE WAS 10. A SECOND SAMPLE OF 26 FILING CLERKS WERE GIVEN THE SAME TEST AND THE DATA FOR THIS GROUP SHOWED A MEAN OF 40 AND A STANDARD DEVIATION OF 8. TEST THE HYPOTHESIS THAT THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS IS ZERO SETTING ALPHA AT THE .05 LEVEL.

NO. 147

SUPPOSE THAT THE AVERAGE SCORE OF A SAMPLE OF 26 MALE HIGH SCHOOL STUDENTS IS 15 POINTS ON A TEST OF MENTAL ARITHMETIC AND THEIR STANDARD DEVIATION IS 12. SUPPOSE FURTHER THAT A SAMPLE OF 37 GIRLS ON THE SAME TEST SHOWED A MEAN SCORE OF 17 POINTS AND A STANDARD DEVIATION OF 15. COMPUTE THE 99 PERCENT CONFIDENCE INTERVAL FOR THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS.

NO. 148

SUPPOSE THAT A SAMPLE OF EMPLOYED MACHINISTS ARE GIVEN TWO FORMS OF THE WHERRY MECHANICAL APTITUDE TEST AND THE FOLLOWING DATA WERE OBTAINED.

INDIVIDUAL 2 FORM A SCORE = 9 FORM B SCORE = 8

INDIVIDUAL 1 FORM A SCORE = 10 FORM B SCORE = 12

INDIVIDUAL 3 FORM A SCORE = 14 FORM B SCORE = 15

INDIVIDUAL 4 FORM A SCORE = 10 FORM B SCORE = 10

INDIVIDUAL 5 FORM A SCORE = 9 FORM B SCORE = 12

INDIVIDUAL 6 FORM A SCORE = 12 FORM B SCORE = 14

INDIVIDUAL 7 FORM A SCORE = 8 FORM B SCORE = 12

INDIVIDUAL 8 FORM A SCORE = 15 FORM B SCORE = 16

INDIVIDUAL 9 FORM A SCORE = 14 FORM B SCORE = 13

INDIVIDUAL 10 FORM A SCORE = 13 FORM B SCORE = 15

TEST THE HYPOTHESIS THAT THERE IS NO SIGNIFICANT DIFFERENCE BETWEEN THE MEANS OF FORM A AND FORM B SETTING ALPHA AT THE .02 LEVEL.

NO. 149

SUPPOSE THAT A SMALL SAMPLE OF RATS ARE GIVEN TWO TRIALS IN A MAZE WITH THE FOLLOWING RESULTS.

RAT 1 ERRORS ON TRIAL 1 = 6 ERRORS ON TRIAL 2 = 4

RAT 2 ERRORS ON TRIAL 1 = 4 ERRORS ON TRIAL 2 = 3

RAT 3 ERRORS ON TRIAL 1 = 8 ERRORS ON TRIAL 2 = 6

RAT 4 ERRORS ON TRIAL 1 = 7 ERRORS ON TRIAL 2 = 7

RAT 5 ERRORS ON TRIAL 1 = 8 ERRORS ON TRIAL 2 = 4

COMPUTE THE 95 PERCENT CONFIDENCE INTERVAL FOR THE DIFFERENCE BETWEEN THE TWO POPULATION MEANS.

NO. 150

ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 111

MEAN Y = 53

VARIANCE X = 78

VARIANCE Y = 29

COVARIANCE XY = 23

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE PERFORMANCE RATING OF THE ITH INDIVIDUAL. SET UP THE STANDARD SCORE REGRESSION EQUATION FOR PREDICTING Y FROM X. GIVEN A Z SCORE OF 1 WHAT WOULD BE THE PREDICTED Z SCORE ON Y.

NO. 151

TEN STUDENTS WERE ADMINISTERED A VERBAL REASONING TEST AND A SPATIAL RELATIONS TEST WITH THE FOLLOWING RESULTS

(SUM X(I) I=1,N) = 43

(SUM Y(I) I=1,N) = 48

(SUM X(I)X(I) I=1,N) = 524

(SUM Y(I)Y(I) I=1,N) = 517

(SUM X(I)Y(I) I=1,N) = 239

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE VERBAL REASONING TEST AND Y(I) RESPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. SET UP THE DEVIATION SCORE REGRESSION EQUATION FOR PREDICTING Y FROM X JOHN HAS A DEVIATION SCORE ON X OF 3 WHAT WOULD BE HIS PREDICTED DEVIATION SCORE ON Y

NO. 152

ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 105

MEAN Y = 73

VARIANCE X = 77

VARIANCE Y = 27

COVARIANCE XY = 24

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE PERFORMANCE RATING OF THE ITH INDIVIDUAL. SET UP THE RAW SCORE REGRESSION EQUATION FOR PREDICTING Y FROM X. SAM HAS AN X SCORE OF 13 WHAT WOULD BE HIS PREDICTED RAW SCORE ON Y.

NO. 153

TEN STUDENTS WERE ADMINISTERED A VERBAL REASONING TEST AND A SPATIAL RELATIONS TEST WITH THE FOLLOWING RESULTS

(SUM X(I) I=1,N) = 42

(SUM Y(I) I=1,N) = 42

(SUM X(I)X(I) I=1,N) = 512

(SUM Y(I)Y(I) I=1,N) = 533

(SUM X(I)Y(I) I=1,N) = 236

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE VERBAL REASONING TEST AND Y(I) RESPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. COMPUTE THE PROPORTION OF VARIANCE IN Y ACCOUNTED FOR BY X.

NO. 154

ONE HUNDRED SCHOOL CHILDREN WERE GIVEN TWO FORMS OF THE POSTON INTELLIGENCE TEST WITH THE FOLLOWING RESULTS

MEAN X = 25

MEAN Y = 23

SIGMA X = 9

SIGMA Y = 9

CORRELATION XY = .80

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON FORM A OF THE TEST AND Y(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON FORM B OF THE TEST. COMPUTE THE STANDARD ERROR OF ESTIMATE FOR PREDICTING Y FROM X.

NO. 155

ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 107

MEAN Y = 73

VARIANCE X = 82

VARIANCE Y = 27

COVARIANCE XY = 22

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE PERFORMANCE RATING OF THE ITH INDIVIDUAL. COMPUTE THE ESTIMATED POPULATION STANDARD ERROR OF ESTIMATE.

NO. 156

TEN STUDENTS WERE ADMINISTERED A VERBAL REASONING TEST AND A SPATIAL RELATIONS TEST WITH THE FOLLOWING RESULTS

(SUM X(I) I=1,N) = 45

(SUM Y(I) I=1,N) = 45

(SUM X(I)X(I) I=1,N) = 545

(SUM Y(I)Y(I) I=1,N) = 536

(SUM X(I)Y(I) I=1,N) = 213

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE VERBAL REASONING TEST AND Y(I) RESPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. SETTING ALPHA AT THE .01 LEVEL. TEST THE HYPOTHESIS THAT THE POPULATION CORRELATION IS ZERO.

NO. 157

ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 106

MEAN Y = 62

VARIANCE X = 84

VARIANCE Y = 30

COVARIANCE XY = 22

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE PERFORMANCE RATING OF THE ITH INDIVIDUAL. SETTING ALPHA AT THE .05 LEVEL. TEST THE HYPOTHESIS THAT THE POPULATION REGRESSION COEFFICIENT FOR PREDICTING Y FROM X IS ZERO.

NO. 158

TEN STUDENTS WERE ADMINISTERED A VERBAL REASONING TEST AND A SPATIAL RELATIONS TEST WITH THE FOLLOWING RESULTS

(SUM X(I) I=1,N) = 41

(SUM Y(I) I=1,N) = 44

(SUM X(I)X(I) I=1,N) = 541

(SUM Y(I)Y(I) I=1,N) = 521

(SUM X(I)Y(I) I=1,N) = 207

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE VERBAL REASONING TEST AND Y(I) RESPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. SETTING ALPHA AT THE .01 LEVEL. TEST THE HYPOTHESIS THAT THE POPULATION MEAN ON THE Y VARIABLE IS 55

NO. 159

ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 110

MEAN Y = 72

VARIANCE X = 99

VARIANCE Y = 30

COVARIANCE XY = 24

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE PERFORMANCE RATING OF THE ITH INDIVIDUAL. COMPUTE THE 99 PERCENT CONFIDENCE INTERVAL FOR THE POPULATION CORRELATION COEFFICIENT.

NO. 160

TEN STUDENTS WERE ADMINISTERED A VERBAL REASONING TEST AND A SPATIAL RELATIONS TEST WITH THE FOLLOWING RESULTS

(SUM X(I) I=1,N) = 43

(SUM Y(I) I=1,N) = 42

(SUM X(I)X(I) I=1,N) = 522

(SUM Y(I)Y(I) I=1,N) = 513

(SUM X(I)Y(I) I=1,N) = 227

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE VERBAL REASONING TEST AND Y(I) RESPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. COMPUTE THE 95 PERCENT CONFIDENCE INTERVAL FOR THE POPULATION REGRESSION COEFFICIENT.

NO. 161

ONE HUNDRED SCHOOL CHILDREN WERE GIVEN TWO FORMS OF THE POSTON INTELLIGENCE TEST WITH THE FOLLOWING RESULTS

MEAN X = 24

MEAN Y = 24

SIGMA X = 8

SIGMA Y = 6

CORRELATION XY = .30

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON FORM A OF THE TEST AND Y(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON FORM B OF THE TEST. COMPUTE THE 90 PERCENT CONFIDENCE INTERVAL FOR THE POPULATION MEAN OF THE DEPENDENT VARIABLE.

NO. 162

ONE HUNDRED APPLICANTS WERE ADMINISTERED A CLERICAL APTITUDE TEST AND WERE RATED ON THEIR JOB PERFORMANCE WITH THE FOLLOWING RESULTS

MEAN X = 120

MEAN Y = 62

VARIANCE X = 76

VARIANCE Y = 29

COVARIANCE XY = 22

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE CLERICAL APTITUDE TEST AND Y(I) REPRESENTS THE PERFORMANCE RATING OF THE ITH INDIVIDUAL. LIST THE ASSUMPTIONS THAT ARE MADE IN TESTING THE HYPOTHESIS THAT THE POPULATION CORRELATION IS ZERO.

NO. 163

ONE HUNDRED SCHOOL CHILDREN WERE GIVEN TWO FORMS OF THE POSTON INTELLIGENCE TEST WITH THE FOLLOWING RESULTS

MEAN X = 21

MEAN Y = 21

SIGMA X = 7

SIGMA Y = 8

CORRELATION XY = .80

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON FORM A OF

THE TEST AND Y(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON FORM B OF THE TEST. LIST THE ASSUMPTIONS THAT ARE MADE IN TESTING THE HYPOTHESIS THAT THE POPULATION REGRESSION COEFFICIENT IS ZERO.

NO. 164

TEN STUDENTS WERE ADMINISTERED A VERBAL REASONING TEST AND A SPATIAL RELATIONS TEST WITH THE FOLLOWING RESULTS

(SUM X(I) I=1,N) = 46

(SUM Y(I) I=1,N) = 43

(SUM X(I)X(I) I=1,N) = 541

(SUM Y(I)Y(I) I=1,N) = 532

(SUM X(I)Y(I) I=1,N) = 224

WHERE X(I) REPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE VERBAL REASONING TEST AND Y(I) RESPRESENTS THE SCORE OF THE ITH INDIVIDUAL ON THE SPATIAL RELATIONS TEST. LIST THE ASSUMPTIONS THAT ARE MADE IN TESTING THE HYPOTHESIS THAT THE POPULATION MEAN OF THE DEPENDENT VARIABLE HAS SOME SPECIFIED VALUE.

NO. 165

GIVEN THE FOLLOWING SET OF ORDERED PAIRS (X,Y).

(2,4) (3,5) (4,6) (5,7) (4,6) (6,8)
(3,2) (4,3) (5,4) (6,5) (5,6) (7,7)
(2,3) (3,4) (4,5) (5,6) (6,7) (7,8)
(2,4) (3,3) (6,2) (5,5) (3,6) (8,8)

COMPUTE

A. MEAN SQUARE LINEAR REGRESSION

B. MEAN SQUARE DEVIATION FROM LINEAR REGRESSION

C. MEAN SQUARE ERROR.

NO. 166

GIVEN THE FOLLOWING SET OF ORDERED PAIRS (X,Y).

(2,3) (3,4) (4,5) (5,6) (6,7) (7,8)
(2,4) (3,3) (6,2) (5,5) (3,6) (8,8)

(3,2)   (4,3)   (5,4)   (6,5)   (5,6)   (7,7)

(2,4)   (3,5)   (4,6)   (5,7)   (4,6)   (6,8)

TEST THE HYPOTHESIS THAT THE REGRESSION IS OF Y ON X IS LINEAR.

NO. 167

A SAMPLE OF MICHIGAN STATE UNIVERSITY STUDENTS WAS ADMINISTED THE BROWN SCHOLATIC APTITUDE TEST ALONG WITH THE GRADUATE RECORD EXAMINATION. IN THIS SAMPLE THE CORRELATION BETWEEN THE TWO TESTS WAS .60 A SECOND SAMPLE FROM RUTGERS UNIVERSITY WAS ALSO GIVEN THE TWO TESTS. IN THE RUTGERS SAMPLE THE CORRELATION BETWEEN THE TWO TESTS WAS .40 TEST THE HYPOTHESIS THAT DIFFERENCE BETWEEN THE CORRESPONDING POPULATION CORRELATION COEFFICIENTS IS ZERO.